

SEVERE STORMS

HEARING

BEFORE THE

SUBCOMMITTEE ON NATURAL RESOURCES,
AGRICULTURE RESEARCH AND ENVIRONMENT

OF THE

COMMITTEE ON
SCIENCE AND TECHNOLOGY
U.S. HOUSE OF REPRESENTATIVES

NINETY-SEVENTH CONGRESS

FIRST SESSION

OCTOBER 6, 1981

[No. 177]

Printed for the use of the
Committee on Science and Technology



U.S. GOVERNMENT PRINTING OFFICE

WASHINGTON : 1983

21-001 O

H701-5

COMMITTEE ON SCIENCE AND TECHNOLOGY

DON FUQUA, Florida, *Chairman*

ROBERT A. ROE, New Jersey
GEORGE E. BROWN, Jr., California
JAMES H. SCHEUER, New York
RICHARD L. OTTINGER, New York
TOM HARKIN, Iowa
MARILYN LLOYD BOUQUARD, Tennessee
JAMES J. BLANCHARD, Michigan
TIMOTHY E. WIRTH, Colorado*
DOUG WALGREN, Pennsylvania
RONNIE G. FLIPPO, Alabama
DAN GLICKMAN, Kansas
ALBERT GORE, Jr., Tennessee
ROBERT A. YOUNG, Missouri
RICHARD C. WHITE, Texas
HAROLD L. VOLKMER, Missouri
HOWARD WOLPE, Michigan
BILL NELSON, Florida
STANLEY N. LUNDINE, New York
ALLEN E. ERTEL, Pennsylvania
BOB SHAMANSKY, Ohio
RALPH M. HALL, Texas
DAVE McCURDY, Oklahoma
MERVYN M. DYMALLY, California

LARRY WINN, Jr., Kansas
BARRY M. GOLDWATER, Jr., California
HAMILTON FISH, Jr., New York
MANUEL LUJAN, New Mexico
HAROLD C. HOLLENBECK, New Jersey
ROBERT S. WALKER, Pennsylvania
EDWIN B. FORSYTHE, New Jersey
WILLIAM CARNEY, New York
MARGARET M. HECKLER, Massachusetts
F. JAMES SENSENBRENNER, Jr.,
Wisconsin
VIN WEBER, Minnesota
JUDD GREGG, New Hampshire
RAYMOND J. McGRATH, New York
JOE SKEEN, New Mexico
CLAUDINE SCHNEIDER, Rhode Island
JIM DUNN, Michigan
BILL LOWERY, California

HAROLD P. HANSON, *Executive Director*
ROBERT C. KETCHAM, *General Counsel*
REGINA A. DAVIS, *Administrator*
GERALD E. JENKS, *Minority Staff Director*

SUBCOMMITTEE ON NATURAL RESOURCES, AGRICULTURE RESEARCH AND ENVIRONMENT

JAMES H. SCHEUER, New York, *Chairman*

GEORGE E. BROWN, Jr., California
JAMES J. BLANCHARD, Michigan
DOUG WALGREN, Pennsylvania
RICHARD C. WHITE, Texas

WILLIAM CARNEY, New York
F. JAMES SENSENBRENNER, Jr.,
Wisconsin
CLAUDINE SCHNEIDER, Rhode Island

*On assignment to Budget Committee for 97th Congress.

CONTENTS

WITNESSES

October 6, 1981:

Hon. Allen E. Ertel, Representative in Congress of the United States from the 17th District of Pennsylvania.....	Page 10
Richard Hallgren, Director, National Weather Service, National Oceanic and Atmospheric Administration; Robert C. Crawford, Assistant Asso- ciate Director, Office of Civil Preparedness, National Preparedness Pro- grams Directorate, Federal Emergency Management Agency, accompa- nied by Charles C. Thiel, Director, Hazard Mitigation Division, Nation- al Preparedness Programs, FEMA; George S. Benton, professor of mete- orology, Johns Hopkins University; and Allen Pearson, professional meteorologist, Kansas City, Kans.....	20

(III)

SEVERE STORMS

TUESDAY, OCTOBER 6, 1981

U.S. HOUSE OF REPRESENTATIVES,
COMMITTEE ON SCIENCE AND TECHNOLOGY,
SUBCOMMITTEE ON NATURAL RESOURCES,
AGRICULTURE RESEARCH AND ENVIRONMENT,
Washington, D.C.

The subcommittee met, at 2:05 p.m., in room 2325 of the Rayburn House Office Building, Hon. James H. Scheuer (chairman of the subcommittee) presiding.

Present: Representatives Scheuer, Carney, and Schneider.

Also present: Representative Winn.

Staff present: Dr. Robert E. Palmer, Science Consultant.

Mr. SCHEUER. The subcommittee will come to order.

I want to apologize for my lateness. This has been a very hectic day and I was unavoidably detained.

I am going to ask unanimous consent to keep the record open in order that I may insert a statement.

[The prepared statement of Mr. Scheuer follows:]

OPENING STATEMENT
HON. JAMES H. SCHEUER
OCTOBER 6, 1981
HEARING ON SEVERE STORMS LEGISLATION

THE SUBCOMMITTEE WILL COME TO ORDER.

TODAY'S HEARING IS ON H.R. 3769, THE SEVERE
STORMS ADVISORY COMMITTEE ACT
OF 1981.

AT THE OUTSET, I WISH TO MAKE CLEAR
THAT I FULLY SUPPORT THE
OBJECTIVES AT THIS LEGIS-
LATION.

EACH YEAR SEVERE STORMS, BE THEY
IN THE FORM OF HURRICANES,
TORNADOES, OR HEAVY THUNDERSTORMS,
TAKE A LARGE TOLL IN LIVES
AND PROPERTY DAMAGE.

IN THE 1970s TORNADOES ALONE ACCOUNTED
FOR AN AVERAGE OF OVER 100 DEATHS

ANNUALLY AND PROPERTY
LOSS IN THE BILLIONS OF
DOLLARS.

PRIOR HEARINGS OF THIS COMMITTEE
HAVE SHOWN THAT IN ANY GIVEN
YEAR, THERE ARE APPROXIMATELY
100,000 THUNDERSTORMS, OF
WHICH 10,000 ARE CLASSIFIED
AS "SEVERE", WITH DAMAGING
WINDS, LARGE HAIL AND POSSIBLE
TORNADOES.

OF THESE 10,000 SEVERE STORMS,
APPROXIMATELY 1,000 OR 10%
SPAWN TORNADOES.

ON THE AVERAGE, 20 OF THESE
TORNADOES WILL BECOME THE
MAJOR VIOLENT TORNADOES
THAT RESULT IN DEATH AND
DESTRUCTION.

THE WEATHER SERVICE, AND PARTICULARLY
THE SEVERE STORMS FORECAST
CENTER, HAS THE UNENVIABLE

TASK OF TRYING TO DETERMINE
WHICH OF THESE 100,000 THUNDERSTORMS
WILL PRODUCE THAT SCORE OF VIOLENT
KILLER TORNADOES.

RECENT ADVANCES IN REMOTE SENSING
TECHNOLOGY AND IN COMMUNICATIONS
SHOW PROMISE OF SUBSTANTIALLY
IMPROVED DETECTION OF SEVERE
STORMS AND OF MORE TIMELY
AND ACCURATE DISSEMINATION
OF WARNINGS TO THE PUBLIC.

OUR SUBCOMMITTEE RECENTLY VISITED
THE NOAA'S ENVIRONMENTAL RESEARCH
LABORATORIES IN BOULDER, COLORADO,
AND HAD THE OPPORTUNITY TO OBSERVE
THE INNOVATIVE AND HIGHLY IMPORTANT
WORK OF THE PROFS--PROTOTYPE REGIONAL
OBSERVING AND FORECASTING SERVICE--
FACILITY.

BOTH PROFS AND THE SEVERE STORMS
FORECAST CENTER IN KANSAS CITY,
MISSOURI HOLD GREAT PROMISE FOR
SIGNIFICANT ADVANCES IN THE
YEARS TO COME.

HOWEVER, DUE TO BUDGETARY
CONSTRAINTS AND LACK OF
COORDINATION OF SEVERE
STORMS PROGRAMS AMONG
SEVERAL FEDERAL AGENCIES,
THIS EFFORT IS PROCEEDING
SLOWLY.

THIS LEGISLATION IS DIRECTED
AT ASSURING THAT THE FEDERAL
AGENCIES COORDINATE
THEIR EFFORTS IN THIS
VITAL AREA.

WHETHER THE APPROPRIATE SOLUTIONS
TO THIS PROBLEM ARE CONTAINED
IN THE LEGISLATION WE HAVE
BEFORE US TODAY IS THE SUBJECT
OF THIS HEARING.

BEFORE WE BEGIN, I WOULD LIKE
TO CALL ON OUR COLLEAGUE FROM
KANSAS, LARRY WINN, THE
DISTINGUISHED RANKING
MINORITY MEMBER OF THE

COMMITTEE.

HE IS AUTHOR OF THIS LEGISLATION.

WE ARE INDEBTED TO LARRY WINN
FOR HIS LEADERSHIP IN
FOCUSING OUR ATTENTION
ON THIS IMPORTANT PROBLEM.

Mr. SCHEUER. I would now like to call on the ranking minority member of the full Science and Technology Committee, the Honorable Larry Winn of Kansas, who is the author of this legislation and who has shown distinguished and highly intelligent leadership in bringing this legislation forward.

Congressman Winn.

Mr. WINN. Thank you, Mr. Chairman. I appreciate your kind words, and I appreciate your scheduling a hearing on this. I am very impressed with the caliber of the witnesses that are to appear here this afternoon, and I intend to be in and out of the meetings as much as I can. I am sorry that I can't stay clear through each one. I do appreciate the opportunity to welcome our witnesses to the hearing today and I want to personally thank you for scheduling the hearing on this topic which I feel is important not only to the people of Kansas and the Plains States, but to large sectors of the rest of the country as well.

I would like to take just a few moments to describe the legislation that I have introduced—H.R. 3769, the Severe Storms Advisory Committee Act—and the purpose behind it.

I will then look forward to the testimony and the comments on the legislation from our witnesses.

H.R. 3769 will establish a Severe Storms Advisory Committee to assure that the severe storms forecasting activities of the various Federal agencies are as coordinated and efficient as possible. This effort will be headed by NOAA, with the cooperation and the participation of DOD, NASA, FAA, and the Federal Emergency Management Agency.

In addition, we have provided for participation on the Advisory Committee by representatives from the basic and applied research community, the State and local civil defense system, weather forecasters, and the general public.

The life of the Advisory Committee is composed of two stages. First, within 1 year of enactment the committee must issue a report to the Congress assessing the severe storms forecasting system, identifying major weaknesses and recommending a program and a timetable to correct those weaknesses.

The second stage is an annual report each March which will assess the progress made and recommend incorporation of any new programs or any new technology that may be appropriate.

I want to point out two additional positive aspects of this legislation. President Reagan has embarked on an ambitious course to reduce the size and the cost of our Federal Government. I fully support him in this effort. That is why this bill does not—let me repeat—does not provide for any new authorization of funds.

I want to emphasize that no new funding is requested. Instead, I fully expect that the costs of the Advisory Committee will be minimal and can be furnished without undue burden from current agency budgets for this important program.

Second, I realize that there are far too many advisory boards and committees in the executive branch that have hung on far past their useful life. The Severe Storms Advisory Committee will go out of business after 5 years. I think that is plenty of time to get the job done right.

Mr. Chairman, this is not a complex bill by any means, but it is a very important bill. Severe storms include not just the tornadoes that plague my native Kansas. It also includes phenomena such as hurricanes. Right away I think you can see how this affects most of the country. The Texas coast, New Orleans, Florida, Pennsylvania, New Jersey, Long Island, New England—all have been hit by severe hurricanes, and are threatened annually. And of course, it is not just the Plains States that are hit by killer tornadoes. In the past decade, tornadoes have devastated communities in Michigan, Ohio, Alabama, Georgia, Kentucky, and elsewhere.

With the growth of the country and the expansion of housing developments into previously sparsely settled areas, hundreds of thousands of citizens and their property are jeopardized. Adequate forecasting of severe storms has become a truly national concern.

We have made great strides in recent years with technology to more accurately monitor the weather and forecast severe storms. Many Federal agencies are involved to some degree. It now remains for us to insure that these latest technologies are put in place and that the up-do-date information they provide is disseminated on a timely basis so that the public will benefit. To this end we must insure adequate coordination among all of the parties involved.

Thank you, Mr. Chairman, for holding these hearings, and I look forward to the witnesses. I want to thank you again personally.

Mr. SCHEUER. Well, thank you Mr. Ranking Minority Member of the full committee. We very much appreciate your intervention and we admire and value your leadership which you have consistently shown on the Science Committee.

We will now call upon Mr. Carney.

Mr. CARNEY. Mr. Chairman, I ask unanimous consent that I may submit my opening statement as part of the record and then we can get right to our most significant witness on that side of the table, the Honorable Mr. Ertel of Pennsylvania.

[The opening statement of Mr. Carney follows:]

Statement of Mr. Carney for hearing on H.R 3769,
Severe Storms Advisory Committee Act of 1981

October 6, 1981

THANK YOU, MR. CHAIRMAN. IT IS INDEED A PLEASURE TO WELCOME OUR WITNESSES HERE TODAY AND ESPECIALLY OUR DISTINGUISHED COLLEAGUE, THE RANKING MINORITY MEMBER OF THE SCIENCE AND TECHNOLOGY COMMITTEE, MR. WINN.

I KNOW THAT OUR COLLEAGUE FROM KANSAS HAS BEEN AT THE FOREFRONT OF THE EFFORT TO IMPROVE THE SEVERE STORMS FORECASTING AND WARNING PROGRAMS WITHIN THE JURISDICTION OF THE FEDERAL GOVERNMENT. HIS BILL, H.R. 3769, WHICH WE ARE CONSIDERING TODAY, IS AN IMPORTANT STEP IN COORDINATING THESE FEDERAL PROGRAMS.

SEVERE STORMS CAUSE A SIGNIFICANT NUMBER OF CASUALTIES AND HUGE AMOUNTS OF PROPERTY DAMAGE EACH YEAR. IN MY OWN CONGRESSIONAL DISTRICT ON THE EASTERN TIP OF LONG ISLAND, THE POTENTIAL IS THERE FOR GREAT DAMAGE TO BE INFLICTED BY A MAJOR HURRICANE. FORTUNATELY, WE HAVE BEEN SPARED SUCH A CALAMITY IN RECENT YEARS -- BUT THE POTENTIAL IS THERE. WHAT INCREASES THE CHANCE FOR A MAJOR CALAMITY IS THE POPULATION BOOM OF THE PAST DECADE ON LONG ISLAND THAT HAS STRAINED OUR ROAD AND TRANSPORTATION NETWORK. THE APPROACH OF A SEVERE HURRICANE NECESSITATING SOME EVACUATION FROM THE AREA WOULD NOW REQUIRE SUBSTANTIAL ADVANCE WARNING. AN EFFICIENT AND ACCURATE SEVERE STORMS FORECASTING AND WARNING SYSTEM IS ESSENTIAL. OBVIOUSLY, THIS AFFECTS NOT ONLY THE AMERICAN MID-WEST BUT MAJOR SECTIONS OF THE ENTIRE COUNTRY.

MR. CHAIRMAN, I CONGRATULATE YOU ON HOLDING THIS HEARING ON SUCH WORTHWHILE LEGISLATION.

Mr. SCHEUER. We will now call upon another colleague of ours on the Science Committee, the Honorable Allen Ertel of Pennsylvania, who is also a very thoughtful and highly intelligent contributing member of the Science Committee.

We are delighted to have you here, Congressman. The floor is yours.

STATEMENT OF HON. ALLEN E. ERTEL, REPRESENTATIVE IN CONGRESS OF THE UNITED STATES FROM THE 17TH DISTRICT OF PENNSYLVANIA

Mr. ERTEL. Mr. Chairman and members of the subcommittee, it is a pleasure for me to have this opportunity to appear before you today to testify in behalf of the important legislation introduced by my distinguished colleague, Mr. Winn.

H.R. 3769, Severe Storms Advisory Committee Act of 1981, would provide a much needed focal point for the setting of research objectives in the area of storm damage mitigation.

Much of the 17th District of Pennsylvania, which I am privileged to represent, is prone to periodic ravaging by the elements, most particularly by the flooding of the Susquehanna River. The Susquehanna is a large river system collecting the runoff from more than a third of the land area of the State of Pennsylvania. It often has been a lethal river, its turbulent force all too frequently breaking over the river's banks and spreading death and destruction over the valley.

For several years now the people of central Pennsylvania have been struggling to find effective means to contain the threat posed by the river, and to some extent we have been successful. But much more remains to be done as long as this needless loss of life and property continues.

One of the more successful efforts has been the creation of an advanced flood warning system designed to accurately predict imminent flooding with sufficient warning to allow evacuation of the affected areas in a safe and orderly fashion.

This warning system, centered around the U.S. Weather Service's station at the Williamsport-Lycoming Airport, is unique in the entire Nation. So I would like to tell you a little about it.

The Susquehanna River system consists of hundreds of small streams and tributaries, many of which are located in remote, mountainous country and far from any permanent settlement.

The Williamsport flood warning system has instrumented the most important of these tributaries with level indicators or stream flow measurement devices which can telemeter readings automatically to the Weather Service's facilities. In addition, the volunteer fire departments, rescue squads, and individuals living near the streams have been identified and they are responsible for communicating flood and rainfall data to the flood network over the telephone system.

The river forecast center then utilizes this input together with conventional meteorological data such as precipitation, snowpack depth, and temperature and weather forecasts to predict the arrival of a flood stage along any part of the river's system. When this occurs, local officials in the affected areas are notified, and if neces-

sary, fire brigades, rescue squads, and civil defense are activated over the EBS radio.

The crucial aspect, the timeliness of the warning, is effectively utilized to prepare for and execute evacuations before the waters actually arrive.

The success of this flood warning system depends upon many technical and administrative factors. A superior knowledge of the topography of the terrain and the hydrology of the river is required. Also, advanced instruments of high reliability and ruggedness together with an effective communications system are essential components.

And finally, procedure and other elements to foster cooperation between several levels of government have to be developed and tested. All of these factors are, in my opinion, amenable to further improvement by careful research and development of new technology.

In the future I would expect to see more reliance on remote sensing techniques to enhance the capabilities of the Williamsport Flood Warning System. Satellite data such as the high resolution photographic imagery now used on Landsat and the infrared interferometers aboard the latest version of GOES spacecraft could be incorporated through the use of large digital computers.

Computer graphics techniques using mapping of streams, lakes and other reservoirs in an appropriate color coding could speed the interpretation of large amounts of data being telemetered or telephoned into the system. Gamma ray sensors aboard aircraft are being developed to accurately measure snowpack depth in inaccessible areas. Advanced radar systems are now available that can better map the extent and locations of storm systems that threaten to bring on flood conditions.

Computer software should be developed to assist planners in optimizing the use of dams and reservoirs to exercise what flood control there is available from these structures and perhaps suggest what new structures might be most effective in flood mitigation.

Mr. Chairman, none of these technologies need to be developed in the laboratory. All are available, in use in various parts of the United States or elsewhere and by various sectors of local and Federal Government. What is needed urgently is a mechanism to bring these several advanced technologies together, to experiment with them until a kind of synergism is achieved in which the total flood control system is much more than the sum of the individual contributing parts.

I urge the subcommittee to study the activities and the achievements at the Williamsport system and to consider using its experience as a test bed upon which to build future systems.

I might just add parenthetically that the subcommittee has been sensitive to the system in the Williamsport area because the last bill released by this subcommittee made the weather station there one of the last that would be eliminated, if ever eliminated, under the elimination of part-time weather stations. I appreciate that, because this is a unique system. It has worked.

I am convinced that this is the most promising and most cost-effective approach we can take to the problems of flood mitigation that plague so much of the United States every year. We in Penn-

sylvania are quite proud of the work accomplished in Williamsport and hope that it may serve as a model for other States and localities coming to grips with their flood problem. However, we are not content to stop and rest here as there is clearly much more that can and must be done.

That concludes my prepared testimony, Mr. Chairman. I will be glad to respond to any questions about the existing system.

[The prepared statement of Mr. Ertel follows:]

TESTIMONY OF

HON. ALLEN E. ERTEL, REPRESENTATIVE, 17th DISTRICT
COMMONWEALTH OF PENNSYLVANIA

Mr. Chairman, and Members of the Subcommittee, it is a pleasure for me to have the opportunity to appear before you today, to testify in behalf of the important legislation introduced by my distinguished colleague, Mr. Winn. H.R. 3769, "Severe Storms Advisory Committee Act of 1981", would provide a much-needed focal point for the setting of research objectives in the area of storm damage mitigation.

Much of the 17th District of Pennsylvania, which I am privileged to represent, is prone to periodic ravaging by the elements, most particularly, by the flooding of the Susquehanna River. The Susquehanna is a large river system, collecting the runoff from more than a third of the land area of the state. It has also been a lethal river, its turbulent force all too frequently breaking over the river's banks, and spreading death and destruction over the valley.

For several years now, the people of central Pennsylvania have been struggling to find effective means to contain the threat posed by the river, and to some extent we have been successful. But much more remains to be done, as long as this needless loss of life and property continues.

One of the more successful efforts has been the creation of an advanced flood warning system, designed to accurately predict imminent flooding, with sufficient warning to allow evacuation of the affected areas in a safe and orderly fashion. This warning system, centered around the U.S. Weather Service's station at the Williamsport-Lycoming Airport, is unique in the entire nation, so I would like to tell you a little about it.

The Susquehanna River system consists of hundreds of small streams and tributaries, many of which are located in remote, mountainous country, and far from any permanent settlement. The Williamsport flood warning system has instrumented the most important of these tributaries with level indicators, or stream flow measurement devices, which can telemeter their readings automatically to the Weather Service's facilities. In addition, the volunteer fire departments and rescue squads, and also individuals living near streams have been identified, and are responsible to communicate flood and rainfall data to the Flood Network, over the telephone system. The River Forecasts Center then utilizes this input, together with conventional meteorological data such as precipitation, snowpack depth and temperature, and weather forecasts to predict the arrival of flood stage along any part of the river's system. When this occurs, local officials in the affected areas are notified, and if necessary, fire brigades, rescue squads, and civil defense are activated over the FBS radio. The crucial aspect, the timeliness of the warning, is effectively utilized to prepare for, and execute evacuations before the waters actually arrive.

The success of this flood warning system depends upon many technical and administrative factors. A superior knowledge of the topography of the terrain and the hydrology of the river is required. Advanced instruments, of high reliability and ruggedness, together with an effective communications system are also essential components. And finally, procedures and other elements to foster cooperation between several levels of government have to be developed and tested. All of these factors are, in my opinion, amenable to further improvement by careful research and development of new technology.

In the future, I would expect to see more reliance on remote sensing techniques to enhance the capabilities of the Williamsport Flood Warning System. Satellite data, such as the high-resolution photographic imagery now used on LANDSAT, and the infrared interferometers aboard the latest version of GOES spacecraft could be incorporated, through the use of large digital computers. Computer graphics techniques, using mapping of streams, lakes and other reservoirs in an appropriate color coding could speed the interpretation of large amounts of data being telemetered, or telephoned into the system. Gamma-ray sensors aboard aircraft are being developed to accurately measure snowpack depth in inaccessible regions. Advanced radar systems are now available that can better map the extent and locations of storm systems that threaten to bring on flood conditions. Computer software should be developed to assist planners in optimizing the use of dams and reservoirs to exercise what flood control there is available from these structures, and perhaps suggest what new structures might be most effective in flood mitigation.

Mr. Chairman, none of these technologies need to be developed in the laboratory. All are available, in use, in various parts of the U.S. or elsewhere, and by various sectors of local and federal government.

What is needed, urgently, is a mechanism to bring these several advanced technologies together, to experiment with them until a kind of synergism is achieved, in which the total flood control system is much more than the sum of the individual contributing parts. I urge the subcommittee to study the achievements at the Williamsport system, and to consider using its experience as a "test-bed", upon which to build future systems. I am convinced that this is the most promising, and most cost-effective approach we can take to the problems of flood mitigation that plague so much of the United States every year. We in Pennsylvania are quite proud of the work accomplished in Williamsport, and hope that it may serve as a model for other states and localities coming to grips with their flood problem. However, we are not content to stop and rest here, as there is clearly much more that can and must be done.

Mr. Chairman, this concludes my prepared testimony, and I will be pleased to try to answer any questions the Subcommittee may have.

Mr. ERTEL. I might point out just one thing again parenthetically. Mr. Winn indicated his bill wouldn't cost any money. I might point out that the Williamsport Flood Control System is a very minimal operation as far as costs. It is basically a volunteer system coordinated to some degree with the Weather Service. But the Weather Service does provide an integral part. We do need professionals in the system who are there. But the major part of it is volunteer.

Mr. SCHEUER. So it is highly consistent with President Reagan's emphasis on voluntarism.

Mr. ERTEL. It certainly is. It is probably one of the better examples of what can be done in that sector. I don't suggest that everything can be done with voluntarism, but in this case, we couldn't find any other way to really solve the problems and the people came forward and tried to. It has worked effectively. We have saved millions of dollars which would have come out of the Federal Treasury through the flood insurance program, which is not operating at any profit by a long shot. Because of advance warning and movement of entire factories out of the flood plain or the movement of machinery from those factories we have saved a tremendous amount of money.

Part of the problem you have is if you have a warning that doesn't come to fruition and everybody is moved, you have got a lot of costs from crying wolf without actual damages.

Mr. SCHEUER. I would like to get some more information on the question of expense as it is important to all of us. How much did it cost to put this program together and would you consider this cost expensive? Is it cost effective?

Mr. ERTEL. Mr. Chairman, I don't have the exact expense figures because it was put together over a period of time. I would say to you that most of it is standard telephones. People use the phones in their homes. They go and they call in to the operation. What you have at the Williamsport Airport is a professional. He is already there. He is with the Weather Service, so it is not an additional expense. He is already paid by the Government. And then he coordinates with the weather forecasting in Harrisburg which already exists.

Now there has been expense to some degree. We have put up some distant remote sensing stream sensors which transmit to a satellite and back. But again, it is minimal. I can't tell you the exact cost, but it is certainly less than one-half million dollars.

Mr. SCHEUER. Our information is that the physical equipment that you have installed cost only \$500, and that you saved three-quarters of a million dollars alone in just one flood in 1979.

Mr. ERTEL. I would accept those figures. I know it has been very minimal what we have put in because we have used existing equipment. But that doesn't mean that it is going to be adequate. As we find continuing meteorological conditions changing, the flooding stages are changing, we are finding that we are going to have different conditions. So I suspect in the future we are going to have to make the system more sophisticated. If all the telephone lines went down in a big storm, the system is virtually inoperable because there is no way to communicate.

Mr. SCHEUER. You need some kind of backup communications system.

Mr. ERTEL. Yes. Absolutely.

Mr. SCHEUER. Have there been any published reports about this?

Mr. ERTEL. Yes, there is. I will be glad to provide one. We do have a report that the flood warning system did publish and I will provide it to the committee. I don't have one with me.

[Information available in committee files.]

Mr. SCHEUER. Is that the flood warning system of the U.S. Army Corps of Engineers?

Mr. ERTEL. They have their own. Lycoming County put out a report that I am aware of and I think the corps has also studied it and put out a report based upon it. Also, it was commented upon in the flood mitigation study done by NSF, which was reported on about a year and a half ago as a result of this committee.

Mr. SCHEUER. Very good.

Is the Corps of Engineers an active participant in the flood control system at Williamsport?

Mr. ERTEL. I don't know what you mean by active participant. They are aware of it. Some of the Army Corps of Engineers activities are coordinated with it. They are not the prime sponsor, if you would put it that way.

Mr. SCHEUER. Well, thank you very much, Congressman. We very much appreciate your testimony. It is really helpful.

Mr. ERTEL. Thank you, Mr. Chairman. Any other questions?

Mr. SCHEUER. Mr. Carney.

Mr. CARNEY. I have no questions.

Mr. SCHEUER. Mr. Winn.

Mr. WINN. As I listen to your testimony I gather that you are basically supporting the bill that I have introduced.

Mr. ERTEL. Absolutely.

Mr. WINN. As a good example of Williamsport and the coordination of the volunteers that are required there, I just wondered, do you remember how long that system has been in operation?

Mr. ERTEL. The system has been in operation since after Agnes in 1972. About 8 years, I guess.

Mr. WINN. I am just wondering if you are aware of any examples of where false warnings were issued or cry wolf situations prevailed where the population doesn't take the threat seriously like we run into in tornadoes.

Mr. ERTEL. It was in the flood control center in the Williamsport area during Eloise and at that point the information was coming in on the flood warning system. A decision had to be made whether to evacuate. There were some decisions whether to call the National Guard in because we were looking at another devastation like Agnes, and the conditions were indicating that. And there was some very deep thought because we knew the tremendous costs that were going to be involved if we did the evacuation.

We made the decision collectively, a lot of us, who were in government there at the time, not to declare the emergency and not to bring the National Guard in. That was the right decision. It turned out to be the right decision. Caution would have said that if we had been a little more cautious we probably would have evacuated in that case.

I know of one other instance where we did put out a warning and they actually did button up a plant ready for it.

Again, the cost in relationship to what would have been lost if we had not taken the preventive measure was so large that you almost had to do the preventive.

Mr. WINN. As I understood your testimony, you pointed out that basically the technology is there. What you are talking about is bringing that technology together at no additional expense, or very little additional expense, to the various agencies that would be involved up there and the local people that are coordinating the efforts, and the volunteers, of course, they wouldn't have much to do with the technology, but the agencies would, to do even a better job than the present system allows.

Mr. ERTEL. Absolutely. One thing, you may have one of your people on a particular stream which is fairly important. Let's assume for a moment he goes on vacation and you have a storm in that area. That may be the crucial piece of information that you are missing in your analysis of what is going to happen. So you have a blank. When you are relying on all volunteers you have very little control, and obviously they have the right to live their own lives. With a more automated system—for example, a sensor system which bounces off a satellite and feeds into your prime

system, your computer center—then your reliance on volunteers decreases.

It seems to me that to have some sort of backup like that can be very important in the long run.

We have other instances where we have received readings from some remote system which have been inaccurate and the volunteer has called in and given the accurate information, and so you rely basically on the person who is there. If he is not, then you take the automatic type of reading.

So I think there is a need for that backup system and we don't always have that available. So your bill would tend to emphasize these improvements. When you get right down to it it becomes very important to have that extra little bit of information, especially when you are talking the amount of damage which Agnes caused. What did it cost? How many billions of dollars? It was the largest devastation that ever happened to this country. No one expected it. Therefore you are talking about very sizeable chunks of money in damages. We should learn from this experience and strive to obtain better information from a better backup system.

Mr. WINN. I think you are talking about two things: information and communication.

Mr. ERTEL. Absolutely.

Mr. WINN. Mr. Chairman, I would hope that any reports that are available on the Williamsport system could be incorporated in the hearing as a part of Mr. Ertel's testimony.

Mr. SCHEUER. Yes; we definitely will incorporate those reports, subject to length, of course. It is our information that the Federal Emergency Management Administration, the Corps of Engineers, the National Weather Service, and the now-defunct Water Resources Council have all analyzed this operation. We will include all of their written reports.

[Report available in committee files.]

Mr. SCHEUER. Congressman Carney.

Mr. CARNEY. Mr. Chairman, I have no questions of the witness. I think his testimony stands for itself. We look forward to getting this bill passed.

Mr. SCHEUER. Very good.

Congresswoman Claudine Schneider.

Mrs. SCHNEIDER. Likewise, Mr. Chairman.

Mr. SCHEUER. Very good.

Mr. ERTEL. Thank you, Mr. Chairman. I just learned something, that there are more reports on this system than I was aware of. So I am finding out something too. I guess a witness always learns something as well.

Mr. SCHEUER. Thank you.

We will now call the panel. We ask all four of you to please be seated.

Dr. Richard Hallgren, Director of the National Weather Service of NOAA; Dr. Robert Crawford, Assistant Associate Director of the Office of Civil Preparedness of the National Preparedness Programs Directorate of the Federal Emergency Management Agency; Dr. George Benton, Department of Earth and Planetary Sciences of Johns Hopkins University; and Mr. Allen Pearson, meteorologist, Kansas City.

Mr. SCHEUER. My colleague Congressman Carney will chair the remainder of this session. I must go to the floor.

Mr. CARNEY [presiding]. Gentlemen, I think what we will do is ask that you not read your entire testimony, but we will submit it as an entire testimony in the record. You would then have an opportunity to chat with us for about 10 minutes apiece and then we will be glad if you would be available for questioning from members of the committee.

Dr. Hallgren, if you would start, we would appreciate it.

STATEMENTS OF RICHARD HALLGREN, DIRECTOR, NATIONAL WEATHER SERVICE, NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION; ROBERT C. CRAWFORD, ASSISTANT ASSOCIATE DIRECTOR, OFFICE OF CIVIL PREPAREDNESS, NATIONAL PREPAREDNESS PROGRAMS DIRECTORATE, FEDERAL EMERGENCY MANAGEMENT AGENCY, ACCOMPANIED BY CHARLES C. THIEL, DIRECTOR, HAZARD MITIGATION DIVISION, NATIONAL PREPAREDNESS PROGRAMS, FEMA; GEORGE S. BENTON, PROFESSOR OF METEOROLOGY, JOHNS HOPKINS UNIVERSITY; AND ALLEN PEARSON, PROFESSIONAL METEOROLOGIST, KANSAS CITY, KANS.

Dr. HALLGREN. I am pleased to have this opportunity to testify on H.R. 3769. The National Weather Service and NOAA agree wholeheartedly that improving our severe weather forecast and warning system deserves substantially more emphasis than we have been able to give it in the past because this Nation is located in such a place that we have a greater frequency of hurricanes, tornadoes, flash floods, winter storms, river flooding, and thunderstorms than any other nation in the world. It is a problem that we have been trying to give attention to in the past, but I think we are now at a threshold both scientifically and technologically to be able to make a great improvement in the overall warning system in the years to come.

Although the Department of Commerce agrees with the objectives of H.R. 3769, we do not support the enactment of the legislation, especially in terms of requiring an Advisory Committee.

I would just like to reflect a minute or two on the overall situation in this country. We have what we consider to be one of the best warning systems of any weather service in the whole Nation. But we know that in many cases we are not able, with our present capabilities, to recognize the clues that take place prior to the occurrence of severe weather events.

In part we are limited by the current state of knowledge and understanding of the structure of the weather systems that determine these small-scale severe weather events, but also in part we are limited by the lack of adequate observations and the capability to process and interpret the data and to disseminate the information in a timely way to the public.

But as I said earlier, I think we can change this situation rather substantially in the coming years by putting together a solid effort across the country focused on the small-scale motions that determine when and where severe weather and flash flooding will take place.

I would like to refer back to a situation that existed in the early 1960's and late 1950's where we saw that our scientific knowledge was adequate and the technology was essentially now to be foreseen to undertake a major effort on the large-scale motions of the atmosphere. And during the 1960's and 1970's this Nation, along with other nations throughout the world, undertook a major effort in that regard.

In my mind, we are at the same point with regard to the severe weather or the small-scale motions of the atmosphere right now. In other words, I picture in the 1980's and 1990's we should be turning our full attention to developing a far better warning system based on the science and technology that we now can foresee. It is not all worked out, but we can foresee it well enough to bring a focused effort.

In my opinion the national effort that is needed should have two major streams of action.

The first one should be to improve the severe weather and flood services, that is, the operation of severe weather and flood services, through the introduction of technology and science that is now already known. That should be a continuing process right through the years.

In parallel we should have a second stream of action which focuses on increasing our scientific understanding and developing further the technologies for detection, forecasting, and dissemination of weather information. This would be basically a supportive research effort.

If we put those two streams of motion together I think we can much enhance the overall warning system.

This effort, I want to emphasize, is not just the National Weather Service; it has to be the whole Nation; it has to be our universities pulling in full concert; it has to mean that industry is carrying their weight on the technological side; and, of course, not just the Weather Service, but the other Federal agencies within the Government must be pulling together in bringing this overall effort to fruition.

It is not that we are not doing something now. I want to emphasize that we are doing something, for example, the Williamsport situation on which the Congressman just testified. By the way, the head of the Williamsport office, Mr. Murray, received a special award within NOAA for his efforts with regard to the flash-flood warning system in that particular area.

Also, we have undertaken on a four-State basis—Pennsylvania, West Virginia, Virginia, and Kentucky—a major effort that was funded by the Congress to put together a flash-flood warning system in a sizeable number of counties. Our proposal had the flavor of working in concert at the Federal level, at the State level, and at the local level with a great deal of volunteers working in concert to make the system a success. We did by trying to focus upon several areas. At one place we use a little higher level of technology to see how well the system will work under that circumstance and continue through to places where we were almost working solely with volunteers. We always try to have a mixture of technology; that is, like automatic sensing devices with a certain

density of observing stations and then try and tighten that up through the use of volunteers.

In fact, volunteers are very much a part of the whole Weather Service across the country. We literally have tens of thousands of storm spotters across the country who are absolutely vital to the tornado forecasting, tornado warning system as well as to the hurricane side and other severe weather events.

We also have 11,000 observers that are volunteers across the country that constitute a very important part of the observational network.

I would like to mention just a couple others. We are now bringing AFOS on line over the next year into an operational mode. We had some difficulty in getting the system up to an operational suitability, but we have accomplished and demonstrated its suitability during the operational demonstration August 17 through 31. Now we are systematically bringing them into operation. It helps. It speeds up the warning process. It automatically drives NOAA weather wire. It gives us the capability of composing the warnings more rapidly. It gives the people a better way of assimilating the information that goes into the decision process that results in a warning.

We are undertaking a development effort headed toward procurement on a triagency basis; that is, DOD, FAA, and NOAA, or the Department of Commerce. We are trying to replace the outmoded, outdated 1957 network radars we have in existence with modern radars that also have a Doppler capability. This capability came out of our research development during the last 10 years.

It is a sizable effort. It is one in which the three agencies are working in concert.

We are trying to expand our use of satellite data down at the local level. The geostationary satellite gives us pictures of great detail that can be used in the whole severe weather process.

We are trying to get more automated stations for making surface observations.

These are some of the things that are going into the first stream.

With regard to research activities, we recently had what I thought was a very successful experiment called the severe environmental storms and mesoscale experiment. It is one which was a large number of scientists from the universities and a substantial number of Federal agencies came together and got a really first-class comprehensive set of data that is the basis for a great deal of research in modeling the small-scale motions in the atmosphere.

Again, the agencies worked in harmony on that and worked in full concert with the universities.

We are now undertaking what is called the prototype regional observing and forecasting system, PROFS, out in Colorado. What we are trying basically to do there is develop the technology so that we can envisage and be in a position to specify the next generation of AFOS which we hope will go into place in about 1990. In other words, that is more to be done. You only go up a flight of stairs a few steps at a time and we have a long way to go in putting that technology to work. But we are working by putting it in place now with AFOS and we are working on the next generation system in the PROFS arena.

The centralized storm information system in which Congressman Winn is vitally interested is now being put in place at a certain level that we think constitutes a viable test for the system at our National Severe Storms Forecast Center. We will be working and evaluating that. It will give us the right information to try and help us specify what the operational system at our national centers should be in the future.

There are a lot of other efforts—Dr. Benton will be talking about them—in the future. Dr. Benton will be referring to one that has been underway this summer in trying to put a solid research program together related to the storm scale or mesoscale.

I would like to just finally mention one thing. Whenever you try to put a program together like this, and I was deeply involved in the overall planning for the world weather watch and the global atmospheric research program, you have to try and harmonize the various ways of developing the program. In the case of GARP we use the National Academy of Sciences to bring together the best scientific planning, best scientists to do the best scientific planning, and then we brought the agencies together under the Federal coordinator for meteorological services and supporting research.

Whenever you have a situation where you have a common goal and common focused effort that can be seen by the various groups, I find it quite easy to bring them all together in developing a good solid plan and then go about carrying it out.

I think that if we concentrate on using some of the existing mechanisms like we did in the case of GARP then we could succeed in this very vital effort that Congressman Winn has identified as being absolutely necessary in order to be able to provide a proper level of warnings in the future to the people of the United States.

Thank you.

[The prepared statement of Dr. Hallgren follows:]

STATEMENT BY

Dr. Richard E. Hallgren
Director, National Weather Service

National Oceanic and Atmospheric Administration

of the

Department of Commerce

Before the
U.S. House of Representatives
Committee on Science and Technology
Subcommittee on Natural Resources, Agriculture Research and Environment

October 6, 1981

Mr. Chairman and Members of the Subcommittee:

I am pleased to have this opportunity to testify on H.R. 3769. We strongly agree that improving severe weather forecasts and warnings to the Nation deserves increased emphasis and believe that mechanisms already exist that can be used to facilitate the development of a national program. Although the Department of Commerce agrees with the objectives of H.R. 3769, for reasons I will discuss, we do not support enactment of the legislation.

The prime mission of the National Weather Service is to reduce the loss of life and property damage resulting from hazardous weather events. This can be achieved through improved detection and prediction of severe weather and timely dissemination of information to the public. Scientific and technological capabilities have evolved to the point where significant progress can be expected from a concerted national effort.

Severe weather events such as tornadoes, flash floods, severe thunderstorms and wind downbursts are associated with small-scale, rapidly changing weather systems often referred to by meteorologists as "mesoscale" systems. In the last 10 years, 80 percent of the

surveys regularly conducted by NOAA following major weather disasters found that mesoscale features provided important clues to the development of the hazardous events. In many cases we have not been able to recognize these clues prior to the occurrence of the severe event. In part, we are limited by the current state of knowledge and understanding of the structure and dynamics of mesoscale weather systems. In part, we are limited by the lack of small-scale, frequent weather observations and the capability to process and interpret relevant data and to disseminate warning information to the public in time for them to take action. However, this situation can be changed.

An analogous situation existed in the early 1960's in relation to large-scale weather systems that determine the changes in weather that occur over periods of a day or longer. Meteorologists often refer to these as "synoptic-scale" weather systems, and they include the lows, highs and fronts commonly depicted on the maps discussed by radio and TV forecasters. During the 1960's and 1970's, scientists, technologists and government agencies in the United States and throughout the world mobilized their talents and resources in a concerted attack on the global, synoptic-scale problem. The problem is inherently global, because weather influences extend across the planet in a few days. Making use of well-developed physical-mathematical theories (or models), high-powered computers, meteorological satellites, and other observing innovations, enormous progress was achieved on the synoptic-scale problem. This progress already is being felt through improvements in the accuracy and time range of

weather forecasts beyond 12 hours, and further improvements are systematically being introduced into operational services around the world.

First class scientists have been turning their attention to understanding the smaller-scale phenomena involved. A deep understanding of the dynamics of the larger scale systems in which severe weather is imbedded provides a firm point of departure, and theoretical and modeling techniques already developed can be refined and extended. Powerful new observing and data processing techniques are becoming available and already have been used for individual experiments and studies. New tools for rapidly interpreting and disseminating information are now available. For the first time, a realistic opportunity for major progress in severe weather services is at hand and can be realized through systematic synthesis and simulation of these developing capabilities.

A national effort built around two major streams is already underway.

- 1) improving severe weather and flood services through the introduction of new science and technology into NWS operations.
- 2) improving scientific understanding, techniques and technology for detection, forecasting and dissemination through a unified program of research and development.

This program would involve the broad community of weather scientists and technologists, private as well as government institutions, and not just the National Weather Service. A number of contributory efforts already are underway across the country, and I want to mention a few

that I am personally familiar with to illustrate the scope of current efforts and the opportunity.

In support of the first, operational service improvement stream of a national program, the following are especially relevant:

Automation of Field Operations and Services (AFOS).

The AFOS program introduces a nationwide network of modern minicomputers and TV-type displays, to reduce the response time between forecast or detection of hazardous phenomena and issuance of warnings to the public, through first, automatic communications; to improve and extend warning and forecast services using computer assistance; and to increase the productivity of field units by automating routine manual functions. AFOS has already demonstrated that it can speed the preparation and dissemination of severe weather and flash flood warnings.

NEXRAD. The Nation's current weather radars are based on WWII technology and are growing obsolete. The next generation weather radar (NEXRAD) will replace them. NEXRAD is being designed for joint acquisition and use by the Departments of Commerce, Defense and Transportation. As a storm detection radar system, NEXRAD will take advantage of both modern, conventional and Doppler radar technology. The operational capability of the system will be enhanced by the use of internal automatic data processing equipment. In demonstration projects doppler radar has shown the capability to detect and track mesoscale events and to

significantly improve the timeliness and accuracy of tornado and severe thunderstorm warnings.

Satellite Data. The application of satellite data is another area where significant development strides have been taking place. NWS and NOAA's National Earth Satellite Service (NESS) work together in the use of satellite derived data. NESS, as the satellite operator, acquires the data, and processes it into a form useful to the field offices of NWS. Emphasis is presently being placed on the use of frequent visible and infrared images obtained from geostationary satellites. In addition, the vertical Atmospheric Sounder (VAS) will provide a vertical profile of temperature and moisture content in the atmosphere. Other cooperative work includes the development of a system that uses satellite data to predict heavy rainfall using interactive computer techniques.

Automation of Surface Observations. We are moving ahead with the development of automatic surface weather reporting systems. Substantial staff time is currently being devoted to making the surface observations required to support our forecast, warning and aviation responsibilities. New technologies are available to automate surface weather observations such as winds, temperature, dewpoint, pressure, and amount of precipitation. Acceptable sensors for ceiling height, visibility, cloud cover, obstruction to vision, and for types of precipitation are in advanced stages of development. Automation of our surface weather observations will provide an opportunity to concentrate on the mesoscale

processes, streamline our field structures, improve the quality and reliability of observations, and provide a truly continuous weather watch. The network can also be expanded into areas that are environmentally inaccessible.

In support of the second stream of a national program, mainly research and development of needed science, techniques, and technology, the following are pertinent:

The Severe Environmental Storms and Mesoscale

Experiment (SESAME). SESAME was a collaborative effort of several Federal agencies and research institutions coordinated by NOAA's Environmental Research Laboratories (ERL). The project consisted of a concentrated field measurement period in 1979 that used combined surface, upper air, airborne, and remote sensor data, and yielded one of the most comprehensive data sets ever assembled on storms. Analysis and research is still continuing from the 1979 field measurements, but new insight as to severe storm structure and evolutions already is coming out.

Prototype Regional Observing and Forecasting Service

(PROFS). ERL, NWS, and NESS scientists are actively collaborating in the development of PROFS. This concept has the ultimate goal of providing the public with improved realtime weather information and forecasts on a local scale. Recent progress in observing and forecasting methods, data processing techniques, and modes of dissemination will be integrated to improve the accuracy of observations and forecasts of local weather conditions. The ERL experimental

facility in Boulder, Colorado, will provide the test bed for a variety of techniques that can be transferred for use by the NWS forecast offices.

Centralized Storm Information System (CSIS). NASA, NOAA, and the University of Wisconsin are jointly developing, and will complete the initial installation of this system at the National Severe Storms Forecast Center (NSSFC) in Kansas City in mid-1982. An interactive computer capability, Centralized Storm Information System (CSIS), will be used to research methods for improved severe weather forecasting based on rapid system response to forecaster's requests for critically important information.

To formulate, a national program to improve short range forecasts and warnings, leading experts in atmospheric science have collaborated in workshops and meetings on various aspects of the problem. The National Academy of Sciences/National Research Council surveyed existing and planned programs of major Federal agencies that are directed at these problems, and recommended an integrated program with specific priority areas of emphasis. The NAS report is just being published. A joint NOAA, U.S. Air Force, U.S. Army contract was established with the University Corporation for Atmospheric Research (UCAR) to develop a prospectus for a National Mesoscale Plan. It is due to be published in 1982. It will be the basis for coordinated and integrated operational agency programs.

I realize this description of on going planning, operational improvement, and research and development programs has been rather detailed. I wanted to reassure you that we recognize the basic problem contained in H.R. 3769 and that we are moving forward

rapidly. We are confident that the forthcoming National Mesoscale Plan can provide the necessary framework for coordination of mesoscale activities and thus address the concerns expressed in H.R. 3769.

A number of advisory and coordination mechanisms already exist that can be used immediately to facilitate the development of a national program and serve the purposes outlined in H.R. 3769. Some of the most important mechanisms include:

The National Research Council of The National Academy of Science (NAS). The National Research Council (NRC) was established by the National Academy of Sciences to associate the broad community of science and technology with the Academy's purposes of furthering knowledge and of advising the Federal Government. The NRC has, through a Select Committee on the National Weather Service, recently reported on the Technological and Scientific Opportunities for Improved Weather and Hydrological Services in the Coming Decade. The Committee was chosen for their special competences and appropriate balance from private industry, universities and the Federal Government.

In its report, the Committee reviewed dissemination systems and the status of NWS forecast services including mesoscale depiction and short-fuse forecasts and recommended improvements.

As mentioned previously, the AD Hoc Panel on Mesoscale Processes of the NRC also is publishing a new report on Current Mesoscale Research in the United States. The NAS/NRC has a proven record of effective coordination through its role in the Global Atmospheric Research Program.

Office of the Federal Coordinator for Meteorology (OFCM).

As part of its responsibility for coordinating meteorological activities, reviewing basic and specialized meteorological requirements, services, and supporting research, and preparing and maintaining a Federal meteorological plan, OFCM addresses directly the objectives of H.R. 3769. The OFCM prepares an annual Federal Plan for Meteorological Services and Supporting Research, which describes the total program for meteorological services. One of these, the National Severe Local Storms Operations Plan, which is updated annually, describes the responsibilities, roles, and procedures followed by NOAA, DOD, FEMA, and FAA, in observing, forecasting, and communicating information on severe local storms over the United States.

I believe that systematic and creative use of the existing mechanisms will allow us to achieve the coordination objectives of the proposed legislation. This concludes my formal statement. I would be pleased to answer any questions you might have.

Mr. CARNEY. Thank you very much, Doctor.

Now, if we could, we would like to hear the testimony of Mr. Crawford from the Federal Emergency Management Agency.

Mr. CRAWFORD. Thank you very much, Mr. Chairman.

Mr. Chairman, members of the committee, accompanying me today is Dr. Charles C. Thiel, Director of the Hazard Mitigation Division, National Preparedness Programs, FEMA.

I am pleased to have this opportunity to present FEMA's views on H.R. 3769, the proposed Severe Storms Advisory Committee Act of 1981.

We do recognize, I might interject, the significance of the issues being addressed and the importance of a sound research base to assist in minimizing the negative consequences of severe storms. Further, we are committed as an agency to measures designed to maximize the application of knowledge in the emergency management process.

By way of summary, I will skip the next paragraph and go to the third paragraph in my printed testimony.

However, since it is our belief that adequate mechanisms exist to achieve the proposed objectives of the legislation, we do not feel it desirable to create a special advisory committee such as that proposed. There appears to be good communications among the relevant agencies at this time and significant input from State and local governments and the private sector.

Some of the mechanisms and activities that we would cite are mentioned in Dr. Hallgren's printed testimony as well, and it would be things like the agreement between the Federal Emergency Management Agency and NOAA with a variety of annexes dealing with a number of particular subject areas, one of which is the disaster mitigation and research area.

There is a memorandum of understanding between FEMA, the Federal Communications Commission, and NOAA for disaster warning and communications involving the Emergency Broadcasting System.

FEMA is an increasingly active participant in the Federal Committee and the Interdepartmental Committees for Meteorological Services and Supporting Research. These committees include representatives of 12 Federal agencies and they work to assure coordination and facilitation. For example, the national local severe storms operations plan is one of the documents prepared under the aegis of these groups.

The National Academy of Sciences/National Research Council has done activities in the meteorological area which address the purposes of the bill.

In addition, as mentioned again in Dr. Hallgren's testimony, there is the National Advisory Commission on Oceans and Atmosphere.

In summary, we believe that the existing Federal meteorological committee structure, when combined with agency cooperation and presently legislated agency responsibilities and authorities, is adequate for insuring solid performance in the area of severe storm problems. Continued and increased collaboration between agencies, particularly FEMA and NOAA, will, as it has in the past, result in

continued accomplishment and improvements on the issues highlighted in the proposed legislation.

Having said this, Mr. Chairman, I would interject that we in FEMA have a strong interest in this area from the perspective of saving lives, reducing injuries and property loss, and minimizing human suffering through the maximum application of knowledge available from the scientific and technological communities.

Since FEMA is charged with overseeing the emergency preparedness and response activities of the Federal Government, if the subcommittee feels that there are specific problems needing attention, we would be delighted to work with you on accomplishing improvements in this area.

Mr. Chairman, this concludes my summary. Dr. Thiel and I will be happy to answer any questions that you or the members might have.

[The prepared statement of Mr. Crawford follows:]

TESTIMONY OF ROBERT C. CRAWFORD
ASSISTANT ASSOCIATE DIRECTOR, OFFICE OF CIVIL PREPAREDNESS
NATIONAL PREPAREDNESS PROGRAMS DIRECTORATE
FEDERAL EMERGENCY MANAGEMENT AGENCY
BEFORE THE SUBCOMMITTEE ON NATURAL RESOURCES,
AGRICULTURE RESEARCH, AND ENVIRONMENT
COMMITTEE ON SCIENCE AND TECHNOLOGY
U.S. HOUSE OF REPRESENTATIVES
OCTOBER 6, 1981

MR. CHAIRMAN, MEMBERS OF THE COMMITTEE, ACCOMPANYING ME TODAY IS DR. CHARLES C. THIEL, DIRECTOR OF THE HAZARD MITIGATION DIVISION, NATIONAL PREPAREDNESS PROGRAMS, FEDERAL EMERGENCY MANAGEMENT AGENCY (FEMA). I AM PLEASED TO HAVE THIS OPPORTUNITY TO PRESENT FEMA'S VIEWS ON H.R. 3769, THE PROPOSED SEVERE STORMS ADVISORY COMMITTEE ACT OF 1981.

THE ACT WOULD ESTABLISH A "SEVERE STORMS ADVISORY COMMITTEE," COMPRISED OF POLICY LEVEL INDIVIDUALS REPRESENTING THE NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION (NOAA), DEPARTMENT OF DEFENSE (DOD), NATIONAL AERONAUTICS AND SPACE ADMINISTRATION (NASA), FEDERAL AVIATION ADMINISTRATION (FAA), AND THE FEDERAL EMERGENCY MANAGEMENT AGENCY. IN ADDITION, REPRESENTATIVES FROM THE NON-FEDERAL COMMUNITY COULD BE ADDED TO BRING THE TOTAL MEMBERSHIP TO NOT MORE THAN 12.

WE DO NOT SUPPORT PASSAGE OF THIS BILL SINCE WE BELIEVE THAT ADEQUATE MECHANISMS EXIST TO ACHIEVE THE PROPOSED OBJECTIVES OF THE LEGISLATION WHICH INCLUDE: THE RECOGNITION OF SEVERE STORMS FORECASTING AS AN UNIQUE PROBLEM, BETTER COORDINATION OF FEDERAL AGENCY ACTIVITIES, AND GENERAL IMPROVEMENTS IN THE AREA OF FORECASTING AND WARNING.

THE MECHANISMS AND ACTIVITIES ALREADY CONTRIBUTING IN THIS AREA ARE:

- THE FEDERAL EMERGENCY MANAGEMENT AGENCY AND THE NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION'S "MEMORANDUM OF UNDERSTANDING," IN THE AREA OF WEATHER DISASTERS AND EMERGENCIES. SPECIFICALLY, THE AGREEMENT HAS ANNEXES THAT DEAL WITH DISASTER WARNING AND COMMUNICATIONS, DISASTER PREPAREDNESS AND DISASTER MITIGATION AND RESEARCH. FEMA TAKES OUR COORDINATION ROLE WITH THE LEAD FEDERAL WEATHER AGENCY VERY SERIOUSLY. WE CONSIDER OUR ACTIVITIES AS CRITICAL IN THE OVERALL FEDERAL RESPONSE TO SEVERE WEATHER DISASTERS.
- THE DEVELOPMENT OF A "MEMORANDUM OF UNDERSTANDING" BETWEEN THE FEDERAL EMERGENCY MANAGEMENT AGENCY, FEDERAL COMMUNICATION COMMISSION, AND THE NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION FOR DISASTER WARNING AND COMMUNICATIONS. THIS AGREEMENT HAS PROVISIONS FOR COORDINATION OF THE EMERGENCY BROADCASTING SYSTEM (EBS). THE EBS IS A CRITICAL LINK IN DISSEMINATION OF SEVERE WEATHER INFORMATION TO THE PUBLIC.
- FEMA IS AN ACTIVE PARTICIPANT IN THE FEDERAL COMMITTEE AND THE INTERDEPARTMENTAL COMMITTEES FOR METEOROLOGICAL SERVICES AND SUPPORTING RESEARCH. THESE COMMITTEES INCLUDE REPRESENTATIVES OF 12 FEDERAL AGENCIES AND THEY WORK TO ASSURE COORDINATION AND FACILITATION OF INTERAGENCY COOPERATION WITH PARTICULAR EMPHASIS ON SEVERE WEATHER EMERGENCIES. FOR EXAMPLE, THE "NATIONAL LOCAL SEVERE LOCAL STORMS OPERATIONS PLAN," AND A SIMILAR "NATIONAL HURRICANE OPERATIONS PLAN" DETAIL INTERAGENCY RESPONSIBILITIES.
- THE NATIONAL ACADEMY OF SCIENCES/NATIONAL RESEARCH COUNCIL ALSO HAS ACTIVITIES IN THE METEOROLOGICAL AREA WHICH ADDRESS THE PURPOSES OF THE PROPOSED BILL.

IN SUMMARY, FEMA BELIEVES THAT THE EXISTING FEDERAL METEOROLOGICAL COMMITTEE STRUCTURE, WHEN COMBINED WITH AGENCY COOPERATION AND PRESENTLY LEGISLATED AGENCY RESPONSIBILITIES AND AUTHORITIES, ARE ADEQUATE FOR ENSURING SOLID PERFORMANCE IN THE AREA OF SEVERE STORM PROBLEMS. CONTINUED AND INCREASED COLLABORATION BETWEEN AGENCIES, ESPECIALLY FEMA AND NOAA, WILL, AS IT HAS IN THE PAST, CONTINUE WORK TOWARD CONTINUED ACCOMPLISHMENT AND IMPROVEMENTS ON THE ISSUES HIGHLIGHTED IN THE PROPOSED LEGISLATION.

MR. CHAIRMAN, THIS CONCLUDES MY REMARKS. DR. THIEL AND I WOULD BE HAPPY TO ANSWER ANY QUESTIONS WHICH YOU OR THE COMMITTEE MAY HAVE.

MR. CARNEY. Well, thank you, Mr. Crawford.

As I said before, your testimony and all the witnesses' testimony will be submitted in whole as a matter of record.

Our next witness is Dr. George S. Benton who is with the Department of Earth and Planetary Sciences at Johns Hopkins University.

Dr. Benton, thank you very much and welcome.

DR. BENTON. Thank you, Mr. Chairman.

I am pleased to have this opportunity to testify before the subcommittee in connection with H.R. 3769. This bill deals with a subject which has been of special interest to me for many years.

The areas in which I have been professionally interested in this subject are summarized in my full testimony. But I would like to remark that since returning early this year to the academic community I have become chairman of a steering committee to set up the University Corporation for Atmospheric Research, the consortium of about 50 universities and colleges with graduate programs in meteorology.

This steering committee, which includes among its members many of the leading meteorologists in our country, is undertaking the task of examining the opportunities and requirements in research and weather forecasting associated with a class of weather systems which Dr. Hallgren called mesoscale and which I prefer to call stormscale.

Whatever you call it, this class of phenomena includes severe storms. The report of our committee, now in preparation, will be completed by the end of this calendar year and will directly relate to the act introduced by Congressman Winn.

With your permission, Mr. Chairman, I would like to forward a copy of our report to the subcommittee as soon as it becomes available.

MR. CARNEY. Yes, sir. We would like to have it.

Do you have any idea of the timeframe?

DR. BENTON. It would be finished by the end of this year, calendar year, too late for the formal report of this hearing.

Mr. CARNEY. We will make note of it, as we have. It is unfortunate it will be too late for us to hold these hearings open for that. Thank you anyhow.

Dr. BENTON. Thank you.

Mr. CARNEY. We will be pleased to have it forwarded.

Dr. BENTON. The bill you are considering today, H.R. 3769, deals with a timely and important subject. Section 2 of the act correctly states that "the problems of severe storms forecasting, warning, and protection are not receiving attention within the Federal Government which is consistent with the resultant loss of life and property damage," and notes that "the severe storms forecasting problem" is one which requires "the focused attention of the Federal Government." The act also accurately points out that although substantial improvements have occurred during the past decade in our ability to predict certain types of severe storms, future changes in our forecast system will "vastly improve the severe storm forecast even further."

I completely agree with these statements, and I appreciate the perception the act shows in identifying an area of weather research and forecasting in which the special attention of the Federal Government is needed and in which the social and economic dividends resulting from such attention will far outweigh the costs.

I would like to review for just a few moments some of the most important technical considerations on which these statements are based.

A very substantial part of our significant weather, the weather that affects the lives and property of our citizens, is related to small-scale phenomena of very limited geographic extent. The meteorologists call such systems stormscale or mesoscale events. Stormscale phenomena include severe weather such as tornadoes or downbursts, violent squall lines and thunderstorms, rain-induced flash floods, or heavy local snows—the type of weather system addressed in H.R. 3769.

They also include important nonviolent phenomena: Freezing rain, dense ground fog or low-lying clouds which disrupt ground or air traffic; persistent temperature inversions that cause extreme local air pollution; or strong nocturnal cooling which combined with local air drainage may produce killing frosts.

Significant stormscale weather is responsible for most weather-related loss of life or property damage. Yet these are the systems which the meteorologists find it most difficult to forecast and to observe. There is a good reason why this is true. Our existing operational weather services, civilian and military, were designed to observe large-scale events.

Our network of observing stations provides adequate general information about these large-scale meteorological systems: The major cyclones and anticyclones, the air masses and the weather fronts which cause our regional weather. It provides only sporadic information about the small-scale weather systems which often occurs between observing stations and very little information about the weather system which affects only a single station.

Our observing system, concentrating as it does on the large-scale weather system, has provided the data base necessary to effect a veritable revolution in our ability to forecast regional weather.

Thirty years ago, when I was a graduate student, forecasting weather one to several days in advance was a subjective process in which the experience and intuition of the individual forecaster played a major role. Today high-speed computers provide regional forecasts up to several days in advance. The accuracy of prediction has increased dramatically: 48-hour forecasts today are comparable in quality to 24-hour forecasts of a generation ago.

Unfortunately, the progress achieved during the last 30 years in improving forecasts of large-scale weather conditions has not automatically resulted in a comparable improvement in forecasting local weather. All too often severe or otherwise significant weather is caused by stormscale systems embedded in the larger-scale weather pattern.

To be useful, predictions of these smaller-scale, short-lived events must be far more precise in both space and time than a regional forecast. For example, a warning that a tornado funnel is approaching a specific city must be accurate in time within minutes and in location within a few miles.

It is quite possible that such a very short-range forecast of severe weather may be missed entirely, even though the regional forecast may be correct in calling for severe thunderstorms, or even the possibility of tornadoes, within a much larger area.

This situation is being changed, but much remains to be done. Needed improvements have not yet been incorporated into our operational system, even though technology exists which makes it possible to observe stormscale weather with increased accuracy, to collect and process the data for use by a forecaster, and to disseminate the information directly to the user, all within a matter of minutes.

A concerted national effort is needed to make these improvements.

As Dr. Haligren indicated, a two-stream effort is needed: An operational program to redesign our observational and forecast services to handle stormscale events more adequately; and a supporting research and development program directed toward improvements in system design, better understanding of stormscale phenomena, and improved forecast capability.

A good beginning has been made in research. Over the past decade powerful new remote sensing instruments have been developed and applied to gain insight in a research mode into the occurrence and structure of stormscale systems.

Most importantly, research has helped us gain insight into the physics and life cycles of severe storms and other significant weather. Unburdened by the requirement to prepare a short-term forecast quickly, research scientists have used high-speed computers to study small-scale weather systems by numerical simulation. Retrospective studies, some using special data sets collected through carefully planned field experiments, have identified new kinds of small weather systems such as something we now call the mesoscale convective complex or have improved our knowledge of how some severe storms such as tornadoes form.

Particular emphasis must be placed on the fine development program which has led to the modern Doppler radar. By measuring the speed with which deflecting cloud droplets are approaching or

receding from the antenna, Doppler radar can measure the spin of a slowly rotating cloud mass. It has been shown that tornadoes form from such spinning clouds. By measuring the magnitude of the spin an excellent forecast can be made of whether or not a given cloud will spawn tornado funnels.

Our research programs have shown that tornado forecasting can be substantially improved by using Doppler radar. The number of successful forecasts can be increased; the frequency of false alarms can be reduced; and the time of warning can be increased significantly.

Time does not permit me to review severe storms research, its accomplishments and opportunities. It is sufficient to note the encouraging progress. There is a growing momentum in our effort to understand stormscale weather phenomena. It is safe to say that for the coming decade the limiting factor in research will not be scientific interest and creativity, nor will it be the difficulty of the problem. If a slowdown does occur, it will be as a result of the limitation of funds.

The situation is much more constrained when we turn to operations, the effort to apply in the real world of weather forecasting the new understanding we have fashioned and now beginning to fashion even better through research.

I have already noted that historically our weather services were designed to measure large-scale atmospheric systems: The occurrence and movement of cyclones and anticyclones, the air masses and fronts that shape regional weather. If our weather services are to be reoriented to deal effectively with the forecasting of severe storms and other small-scale events, they must be changed in some very fundamental ways. Observational systems must be modernized to introduce Doppler radar and other remote sensing techniques; communications systems must be introduced which are able to collect and analyze masses of weather information quickly and effectively, such as the McIDAS system which you saw, Congressman Winn, in action in Wisconsin; new ways also must be found to distribute weather information to the public and to user agencies without unnecessary delay. Forecasters knowledgeable about stormscale weather must be trained.

The task that lies ahead is well known to leaders in the weather services of the civil and military communities. The problem is not identifying what needs to be done; the problem, quite frankly, is obtaining the necessary resources in a time of stringent budgets and declining Federal spending.

One example will be sufficient to emphasize this difficulty. Our existing national weather radar network is based upon an outmoded, non-Doppler radar designed in 1957. We urgently need to replace these radars with modern equipment. The necessary research has been done. We know the kind of equipment we need. We know that it will pay dividends in terms of improved stormscale forecasting.

The NEXRAD program, which Dr. Hallgren mentioned, an inter-agency effort of NOAA, NASA, and the FAA, has been mounted to bring about the necessary change. I am pleased to note that NEXRAD was included in the President's fiscal year 1982 budget. However, the program has been slowed down to spread the cost

over a period of years so that in all likelihood the new radar system will not be fully operative until the end of the present decade.

I would like to just remark that this is one of many necessary steps. The fact that it has taken over a decade from conception to implementation as a minimum to bring it into reality—and it isn't yet a reality, as it may be a decade before it becomes a reality—is an indication of the kinds of problems we face.

Mr. Chairman, I realize all too well the difficulty of the priority decisions on funding which Congress is facing. But let's not fool ourselves or the public. If we are not able to find some way to fund the necessary improvement in operational weather forecasting, the job will not get done and we will have to make do with the present system.

I would like to return now to H.R. 3769. The objectives of the act are laudable and well stated. The need for improved severe storm research and forecasting is substantial. The technology and knowledge is at hand to make major progress, as the act states in section 2.

The act calls for the establishment of an advisory committee to develop a program of severe storm forecasting and research and to oversee the program on a year-to-year basis. The concept of an advisory committee is laudable. I endorse it in principle. However, I believe two changes are needed. Let me state my concerns.

First, I believe it would be appropriate to broaden the task of the advisory committee. The problem of severe storms is not an isolated one. The forecasting of severe storms can be substantially improved only when our ability to forecast a wide variety of less severe, small-scale weather events is also substantially improved.

My friends at the university in biophysics and biochemistry tell me that we cannot understand the biology of the abnormal cancer cell until we first understand the biology of the normal cell. Similarly, we will never understand the dynamics of the severe thunderstorm which produces a devastating flash flood unless and until we understand the dynamics of a normal thunderstorm which may only bring rain helpful to the farmer.

The problem of severe storms is an integral part of a larger problem—the reorganization of our research and our services to cope adequately with the prediction of small-scale weather.

Second, I am concerned about the composition of the committee. Policy level officials of the Federal Government who carry administrative and operational responsibilities are commingled with private citizens who have no such responsibilities. Quite frankly, I think this is unsound. The advisory committee, in my opinion, should be set up in a way that clearly places it outside of the executive branch. To do otherwise might subject its reports to internal review and clearance within the executive branch. I am very much afraid the Congress would get cold potatoes instead of steak.

Mr. Chairman, I deeply appreciate the positive objectives and thinking set forth in H.R. 3769 with regard to the needs of severe storm research and forecasting. I would like to respectfully suggest, however, that there is a much more fundamental question of which this is a part: How can we obtain the resources necessary to reorganize and revitalize our weather services without overloading the

Federal budget at a time when constraints on public expenditures are very severe? I think this is a problem that many of us in the academic community have been doing some very careful soul-searching and thinking about, and I hope very much that we can discuss this problem sometime in the future.

Thank you very much, Mr. Chairman. Thank you, Congressman Winn. I appreciate the opportunity for appearing before this subcommittee.

[The prepared statement of Dr. Benton follows:]

COMMITTEE ON SCIENCE AND TECHNOLOGY
SUBCOMMITTEE ON NATURAL RESOURCES, AGRICULTURE RESEARCH and ENVIRONMENT

THE SEVERE STORMS ADVISORY COMMITTEE ACT OF 1981

H. R. 3769

Testimony by

George S. Benton
Professor of Meteorology
The Johns Hopkins University

October 6, 1981

BEST COPY AVAILABLE

THE SEVERE STORMS ADVISORY COMMITTEE ACT OF 1981 (H.R. 3769)

Testimony by George S. Benton

I am pleased to have the opportunity to testify before the Subcommittee on Natural Resources, Agriculture Research and Environment in connection with H. R. 3769, the Severe Storms Advisory Committee Act of 1981. This bill deals with a subject which has been of special interest to me for many years.

Perhaps it would be useful if I briefly summarize my professional experience, so that the members of the Subcommittee can fully understand my background and my involvement with the problem of severe storms. I have been active in meteorological research and science administration for over forty years, and am a Past-President of the American Meteorological Society. My present position is Professor of Meteorology at The Johns Hopkins University. From 1966-69 I was Director of the Environmental Research Laboratories, now a part of the National Oceanic and Atmospheric Administration (NOAA). More recently, I served for three years as the Associate Administrator of NOAA. Especially in the latter two posts, I was closely involved with severe storms research and with related problems of operational meteorology.

Since returning early this year to the academic community, I have become Chairman of a ~~steering~~ Steering Committee, set up by the University Corporation for Atmospheric Research (UCAR) -- a consortium of about fifty universities and colleges with graduate programs in meteorology. This Steering Committee, which includes among its members many of the leading meteorologists in our country, has undertaken the task of examining the opportunities and requirements in research and weather forecasting associated with a class of weather systems called stormscale or mesoscale by meteorologists. This class of phenomena includes most severe storms. The report of our Committee, now in preparation,

will be completed by the end of this calendar year and will directly relate to the Act introduced by Congressman Winn. With your permission, Mr. Chairman, I would like to forward a copy of our report to the Subcommittee as soon as it becomes available. For the present, however, I must make it clear that the testimony I shall present represents my own opinion. I do not speak for our [REDACTED] Steering Committee, for UCAR, for The Johns Hopkins University, or for any other organization.

The bill you are considering today, H.R. 3769, deals with a timely and important subject. Section 2 of the Act correctly states that "the problems of severe storms forecasting, warning, and protection are not receiving attention within the Federal Government which is consistent with the resultant loss of life and property damage," and notes that "the severe storms forecasting problem" is one which requires "the focused attention of the Federal Government." The Act also accurately points out that although substantial improvements have occurred during the past decade in our ability to predict certain types of severe storms, future changes in our forecast system will "vastly improve the severe storm forecast even further." I completely agree with these statements, and I appreciate the perception the Act shows in identifying an area of weather research and forecasting in which the special attention of the Federal Government is needed and in which the social and economic dividends resulting from such attention will far outweigh the costs.

I would like to review some of the technical considerations on which these statements are based. Weather comes in a wide range of geographic scales. The steady rains that cause spring floods on the Mississippi may cover a dozen states and hundreds of thousands of square miles, while a violent tornado may leave a wake of destruction measuring only a hundred yards in width and a fraction of a

mile in length. Weather occurs on all scales between these two extremes; there is no way to "sort out" the different types of weather into convenient size categories.

Nevertheless, a very substantial part of our significant weather-- which affects the lives and property of our citizens-- is related to small scale phenomena of very limited geographic extent. The meteorologist calls such systems stormscale or mesoscale events. Stormscale phenomena include severe weather such as tornados or downbursts, violent squall lines and thunderstorms, rain-induced flash floods, or local heavy snows-- the type of weather system addressed in H.R. 3769. They also include important non-violent phenomena: freezing rain, dense ground fog, or low lying clouds which disrupt ground or air traffic; persistent temperature inversions that cause extreme local air pollution; or strong nocturnal cooling which combined with local air drainage may produce killing frosts.

Significant stormscale weather is responsible for most weather-related loss of life or property damage. Yet these are the systems which the meteorologist finds it most difficult to observe and forecast. There is a good reason why this is true. Our existing operational weather services, civilian and military, were designed to observe large scale events. Weather stations which take surface observations for weather forecasts are spaced 50 to 80 miles apart; stations which measure winds and temperatures through the depth of the atmosphere are spaced even more widely - 200 to 300 miles on the average. This network provides adequate general information about large scale atmospheric systems: the major cyclones and anticyclones, the air masses and the weather fronts which cause our regional weather. It provides only sporadic information about the small scale weather system which occurs between observing stations, and very little information about the weather system which affects only a single station. It is strange but true that our

standard observational network for collecting and distributing weather information provides the forecaster in Kansas City with better information about the weather and structure of the atmosphere over San Francisco or New York than about the weather and structure of the atmosphere over Independence, Missouri, fifteen miles away.

Our observing system -- concentrating as it does on large scale weather -- has provided the data base necessary to effect a revolution in our ability to forecast regional weather. Thirty years ago, forecasting weather one to several days in advance was a subjective process in which the experience and intuition of the individual forecaster played a major role. The mathematical equations describing the large scale behavior of the atmosphere were known, but they were too complex to solve by any known mathematical technique. Today, using high speed digital computers, these equations are solved by numerical integration to provide regional forecasts up to several days in advance. The accuracy of prediction has increased dramatically: forty-eight hour forecasts are comparable in quality to the twenty-four hour forecasts of a generation ago.

Unfortunately, the progress achieved during the last thirty years in improving forecasts of large scale weather conditions has not automatically resulted in a comparable improvement in forecasting local weather. All too often, severe or otherwise significant weather is caused by stormscale systems embedded in the larger scale weather pattern. To be useful, predictions of these smaller-scale, short-lived events must be far more precise in both space and time than a regional forecast. For example, a warning that a tornado funnel is approaching a specific city must be accurate in time within minutes and in location within a few miles. It is quite possible that such a very short range forecast of severe weather may be missed entirely, even though the regional forecast may be correct in calling

for severe thunderstorms (or even the possibility of tornados) within a much larger area.

This situation can be changed and is being changed. Modern research fore-shadows a steady improvement in our ability to forecast changes in the structure or direction of motion of stormscale systems. Radar and orbiting and geo-stationary satellites provide an up-to-the-minute way of viewing stormscale weather phenomena. But much remains to be done. Needed improvements have not yet been incorporated into our operating system, even though technology exists which makes it possible to observe stormscale weather with increased accuracy, to collect and process the data for use by the forecaster, and to disseminate information directly to the user-- all within a matter of minutes.

A concerted national effort is needed to assemble the observation, analysis, and information dissemination systems necessary to provide accurate short-range forecasts for government and for the public. Such a program would reduce loss of life, destruction of property, and the disruption of social activities which occur as a result of severe storms. It would also reduce the damaging impact of other, less violent types of significant weather.

A two-stream effort is required: an operational program to redesign our observational and forecast services to handle stormscale events more adequately; and a supporting research and development program directed toward improvements in system design, better understanding of stormscale phenomena, and improved forecast capability. These two programs need to be closely coordinated. Problems of operational meteorology must be communicated to the research community; advances in observational capability or in fundamental understanding need to be translated into operations.

A good beginning has been made, especially in research. Over the past decade, powerful new instruments have been developed and applied to gain insight into the occurrence and structure of stormscale systems. Hardware and software, such as the experimental McIDAS system at the University of Wisconsin, have been created to collect and analyze stormscale weather information. Programs such as PROFS, in NOAA's Environmental Research Laboratories, are studying the problem of how to disseminate stormscale weather forecasts to the public, rapidly and effectively. Most importantly, research has helped us gain insight into the physics and life cycle of severe storms and other significant weather. Unburdened by the requirement to prepare a short-term forecast quickly, research scientists have been able to use high speed computers to study small scale systems by numerical simulation. Retrospective studies, some using special data sets collected through carefully planned field research experiments such as CCOPE, have identified new kinds of weather systems (such as the MCC-- the Mesoscale Convective Complex) or have improved our knowledge of how some severe storms (such as tornados) form.

Particular emphasis must be placed on the fine development program which has led to the modern doppler radar. By measuring the speed with which reflecting cloud droplets are approaching or receding from the antenna, doppler radar can measure the spin of a slowly rotating cloud mass. It has been shown that tornados form from such spinning clouds. By measuring the magnitude of the spin an excellent forecast can be made of whether or not a given cloud will spawn tornado funnels. Our research programs have shown that tornado forecasting can be substantially improved by using doppler radar. The number of successful forecasts can be increased; the frequency of false alarms can be reduced; and the time of warning can be lengthened significantly. In addition, doppler radar can be used to detect gust fronts in clear air by measuring reflected energy from temperature

and moisture discontinuities in the turbulent atmosphere near the ground.

Time does not permit-- nor is this the proper forum-- to review severe storm research, its accomplishments and opportunities. It is sufficient at this time to note the encouraging progress. New ideas-- new avenues of approach being advanced by the research community-- indicate a growing momentum in the effort to understand stormscale weather phenomena. Obviously, conceptual difficulties will arise and occasional setbacks will occur. But it is safe to say that for the coming decade the limiting factor will not be scientific interest and creativeness, nor will it be the difficulty of the problem. It is clear that if a slowdown does occur, it will be as a result of limitation of funds.

The situation is much more constrained when we turn to operations-- the effort to apply in the real world of weather forecasting the new understanding we have fashioned through research. I have already noted that historically our weather services were designed to measure large scale atmospheric systems: the occurrence and movement of the cyclones and anticyclones, the air masses and fronts, that shape the distribution of regional weather. If our weather services are to be reoriented to deal effectively with the forecasting of severe storms and other small scale events, they must be changed in some fundamental ways. Observational systems must be modernized, to introduce doppler radar and other new techniques; communication systems must be introduced which are able to collect and analyze masses of weather information quickly and effectively; new ways must be found to distribute weather information to the public and user agencies without unnecessary delay. Forecasters knowledgeable about stormscale weather must be trained.

The task that lies ahead is well known to leaders in the weather services of the civil and military community. The problem is not identifying what must be

done - all of us agree on that. The problem is obtaining the necessary resources in a time of stringent budgets and declining Federal spending.

One example will be sufficient to emphasize the difficulty. Our existing National Weather Radar Network is based upon an outmoded, non-doppler radar designed in 1957. We urgently need to replace these radars, for which spare parts are no longer available, with a modern doppler system. The necessary research has been done. We know the kind of equipment we need. We know that it will pay dividends in terms of improved stormscale forecasting. The NEXRAD Program-- an interagency effort of NOAA, NASA, and the FAA-- has been mounted to bring about the necessary change. I am pleased to note that NEXRAD was included in the President's FY82 budget. However, the program has been slowed down-- to spread the cost over a period of years-- so that in all likelihood the new radar system will not be fully operative until the end of the present decade.

Other examples can be cited. Mr. Chairman and Members of the Subcommittee: I realize the difficulty of the priority decisions of funding which the Congress is facing. I can understand that the Congress might come to the conclusion that our nation cannot afford at this time to invest the required funds in restructuring and modernizing our weather services - although I believe that such a decision would be erroneous in view of the substantial economic benefits that would result from such an action. But let us not fool ourselves or the public. If we are not able to find some way to fund the necessary improvement, the job will not get done and we will have to "make do" with our existing system.

In 1980 a Select Committee of the National Academy of Sciences and the National Academy of Engineering was formed to review the National Weather Service. Members of this committee were leaders in industry and technology; most were not meteorologists. In their report, entitled Technological and Scientific Opportunities for Improved Weather and Hydrological Services in the Coming Decade, they stated;

"There will be scientific and technological opportunities in the coming decade to make substantial improvements in the quality and quantity of weather and hydrological services, including initiation of new kinds of services that have been impracticable to establish in the past. These services will provide weather information that is required by an advanced society to provide timely warnings of hazardous weather and flooding; optimize the production of food and fiber and the production, distribution, and conservation of energy; manage water resources; provide vital planning and scheduling assistance to the transportation and construction industries; and increase the general well-being of the individual citizen."

The committee called for substantial real growth in the budget of the National Weather Service. Needless to say, this has not occurred-- nor do I think there is any likelihood that it will occur in the near future. Yet the report is a good one. It estimates realistically the cost of placing in operation many of the fine advances shown to be possible by our research.

Let me return now to H.R. 3769. The objectives of the Act are laudable and well stated. The need for improved severe storm research and forecasting is substantial. The technology and knowledge is at hand to make major progress, as the Act states in Section 2.

The Act calls for the establishment of an Advisory Committee, to develop a program of severe storm forecasting and research and to oversee the program on a year-to-year basis. The concept of an Advisory Committee is laudable; I can endorse it in principle. However, two changes are needed. Let me state my concerns:

First, I believe it would be appropriate to broaden the task of the Advisory Committee. The problem of severe storms is not an isolated one. The forecasting of severe storms can be substantially improved only when our ability to forecast a wide variety of less severe, small scale weather events is substantially improved. My friends in biophysics and biochemistry tell me that we cannot understand the biology of the abnormal cancer cell unless we first understand the biology of the normal cell. Similarly we will never understand the dynamics of the severe thunderstorm which produces a devastating flash flood unless and until we understand the dynamics of a normal thunderstorm. The basic problem is the reorganization of our research and services to cope adequately with the prediction of small scale (stormscale) weather.

Second, I am concerned about the composition of the committee. Policy level officials of the Federal Government, who carry administrative and operational responsibilities, are comingled with private citizens who have no such responsibilities. This is, I believe, unsound. The Advisory Committee should be set up in a way that clearly places it outside of the Executive Branch. To do otherwise would be to subject its reports to internal review and clearance by OMB. The Congress would get cold potatoes, not steak.

Mr. Chairman, I deeply appreciate the positive objectives and thinking set forth in H.R. 3769 with regard to the needs of severe storm research and forecasting. I would like to respectfully suggest, however, that this Subcommittee and the Congress might well examine a more fundamental question: how to obtain the resources necessary to reorganize and revitalize our weather services without overloading the general budget at a time when constraints on public expenditure are severe. This question is one about which many of us are trying to think creatively. It is a subject which is being vigorously discussed at meetings of the UCAR Committee which I chair. I hope I can communicate to you in the near future some of our thoughts on this matter.

Thank you, Mr. Chairman, for the opportunity to testify before your Subcommittee.

Mr. CARNEY. Thank you, Doctor. We certainly appreciate your testimony.

Our next witness is Mr. Pearson, who was the Director of the National Severe Storms Forecast Center in Kansas City from 1965 through 1979. He is a professional meteorologist now from Kansas City. We welcome you, Mr. Pearson.

Mr. PEARSON. Thank you, Mr. Chairman.

During that 15 years with the Center I think I was involved in about 11,500 tornadoes, which is a fair number to have to worry about. I have been involved with more weather-related disasters than I care to think of, including the massive tornado outbreak of April 3 and April 4, 1974, the Palm Sunday outbreak of 1965, numerous blizzards, the Kansas City flood of 1977, many hurricanes and typhoons, including Camille, Dora, Allen, and even a rare hurricane in the Hawaiian Islands. I have testified at four major aircraft accident investigations caused by weather, the most recent being the Southern Airways crash near Atlanta.

The year 1981 has been a very quiet weather year. There was no Gulf of Mexico hurricane and the Caribbean hurricanes formed well to the north of the formation zones for potential danger to the islands or to the United States.

The early drought gave way to heavy summer rains, but flooding has been comparatively minor. There have been a large number of minitornadoes thus far, but very few of the maxitornadoes and none in any major population center. All in all it has been a very good year and it will probably lead some of the speakers into testifying that everything is first rate and that H.R. 3769 is not needed. To this I must say balderdash. Lady Luck has been on our side, but we cannot count on her forever.

Weather travels in cycles. In the Book of Genesis, Joseph prepared for the 7 lean years by storing crops from the 7 good years. We do not understand the drought cycles, although there is some suggestion in the literature that rainfall maximum and minimum are tied to the sunspot cycle, although the physical connection is vague. April, May, and June are the key months for tornadoes and pretty much determine how well or how poorly the Nation will fare. We have averaged a major outbreak once every 6 or 7 years, and it has been more than 7 years since Xenia, Ohio, was hit in 1974. The hurricane situation is less clearcut.

Dr. Neil Frank, Director of the National Hurricane Center, also a Kansan, has been crisscrossing the coastal areas warning what a major hurricane would do to escape routes and to the poorly built high-rise buildings that are popping up near the coastal areas. Dr. Frank demonstrates convincingly that at least 24 hours of advance warning time is necessary for evacuation in many areas, and that advance forecast time puts an undue burden on the present day forecasting capability. How will it be if the hurricane forecasting service suffers from reduced data input during the coming lean years?

It is no coincidence that I have used the phrase "lean years," for weather forecasting is coming into this period. Part of it is the forthcoming budget cuts. Hourly weather reports, radar reports, spotter reports, aircraft reports, and satellite observations are the raw materials that go into making the forecast and preparing the

warning. The raw materials are drying up in the Midwest and there is nothing new on the horizon to take their place. The Doppler radar program is years away from becoming operational and even if it should be in place it does nothing for the forecaster in the period from 30 minutes to 3 hours prior to the event.

I should add that the radar in Kansas City is Radar model No. 1, the first one built in 1957. So it is the oldest one in the system.

As NWS stations are closed the warning responsibility will be duly passed to another office that already has more than it can handle. Station B will do the very best they can when station A closes, but there will be a limit, and there is already a demonstrated tendency to cry wolf.

I started a warning verification program in 1976 for the entire United States for both the tornado and severe thunderstorm. The present-day weather radar is inadequate for the job, for it cannot detect tornadoes per se, nor can it be sure that the thunderstorm contains damaging wind or hail.

As a result, the overworked and understaffed field stations are cranking out more warnings than is justified in an effort to make sure they are covered, and nearly 90 percent of the warnings are radar derived. At the present time five out of every six warnings do not verify.

This is one of the major problems that has not been addressed within the present framework and one of the reasons I so strongly support H.R. 3769. The major reason for the formation of the Weather Bureau in 1870 concerned forecasting for storms, and even today the avowed top priority of the National Weather Service is the same. But the NWS is part of NOAA and far too many of the NOAA officials do not comprehend how the weather forecast and warning service works. They are from other disciplines and more interested in fish, whales, tuna, baby seals, and coastal zone management.

I couldn't have put that in if I was speaking as a Government witness.

The research program within NOAA has been badly fragmented. The National Severe Storms Lab at Norman, Okla., would appear to be the ideal organization to provide the operational arm of NOAA with forecasting and warning improvements. But they have never been funded for the forecasting part. The NOAA labs at Boulder, Colo., have gone off on different tangents, reacting more toward the way they think the NWS of the future should look like rather than helping the operational arm with today's problems.

There has been a mechanism, at least on paper, that might have addressed some of the problems cited, that is, the Office of Federal Coordinator. The office routinely prepares a national plan, taking bits and pieces of each agency's individual plan. Since the Office of Federal Coordinator resides in the NOAA superstructure, they are not independent nor do they make much of a point in probing for weaknesses or in finding solutions, especially if it might cost money.

As a case in point, it is very possible for the Department of Defense Air Weather Service to issue their version of a tornado watch or warning for a geographical area while the National Weather Service decides not to. At the present time the National Severe

Storms Forecast Center cannot even find out what the NWS at Offutt has forecast.

Another unaddressed problem involves warnings. A National Weather Service field office might issue a warning for a rural county that has an FAA facility in it, such as a VOR. Yet that warning does not get into the FAA's communication system with any 24-hour-a-day certainty so that an unsuspecting flight might be headed toward that VOR without knowing that a warning is in effect for the airspace they are flying in.

These are only two of the problems that have been addressed time and time again but have never been resolved by the existing mechanism.

I believe that the Severe Storms Advisory Committee will be a worthy addition if the policy level individuals are willing to make it so. They must be willing to look at the nitty-gritty of how station *x* does. They must be willing to tackle the major problems of independent television station radars.

For example, in Minneapolis-St. Paul, there are three stations that have better equipment than the National Weather Service, including Doppler radar, playback video equipment, and their own computers. And if I was in Minneapolis in charge of the Weather Service I would watch them rather than using our own equipment.

There are at least two television stations in the country with their own Doppler radar and in some markets there may be as many six different weather radars watching the same storm evolution.

The representatives from outside of NOAA, DOD, NASA, and FAA must be given sufficient time and support to develop their independent views, otherwise they will be overwhelmed with incumbents who will come in and instruct you not to rock the boat.

There must be a provision for a minority report if more than one member is willing to sign it. For that reason I believe the committee should be a little larger and that the bill should address the need for a permanent employee to make sure that this doesn't become another paper tiger by being too closely aligned with one of the principal agencies. Might I suggest that it be chaired by someone from NSF with membership open to the Bureau of Reclamation as well.

I greatly appreciate this opportunity and will be more than happy to answer any questions.

Thank you.

[The prepared statement of Mr. Pearson follows:]

My name is Allen Pearson and I live at 426 Navajo in Kansas City, Kansas. I was the Director of the National Severe Storms Forecast Center from 1965 through 1979, and Regional Director for 14 midwestern states from 1979 through June of this year. I have been involved with more weather related disasters than I care to remember, including the massive tornado outbreak of April 3-4, 1974...the Palm Sunday outbreak of 1965...numerous blizzards...the Kansas City floods of 1977...many hurricanes including Camille, Dora, Allen...and even a rare hurricane in the Hawaiian Islands. I have testified at four major aircraft investigations caused by weather, the most recent being the Southern Airways crash near Atlanta.

1981 has been a very quiet weather year. There was no Gulf of Mexico hurricane and the Caribbean hurricanes formed well to the north of the formation zones for potential danger to the islands or to the United States. The early drought gave way to heavy summer rains, but flooding was comparatively minor. There have been a large number of mini-tornadoes thus far, but very few of the maxi-tornadoes and none in any major population center. All in all it has been a very good year and it will probably lead some of the speakers in to testifying that everything is first rate and H.R. 3769 is not needed. To this I will say "Balderdash". Lady Luck has been on our side, but we cannot count on that forever.

Weather travels in cycles. In the Book of Genesis, Joseph prepared for the seven lean years by storing crops from the seven good years. We do not understand the meteorological cycles, although there is some suggestion in the literature that rainfall maxima and minima are tied to the sunspot cycle, although the physical connection is vague. April-June are the key months for tornadoes and pretty much determine how well or how poorly the nation will fare. We have averaged a major outbreak once every six or seven years, and it has been more than seven years since Xenia, Ohio was hit. The hurricane situation is less clear cut.

Dr. Neil Frank, Director of the National Hurricane Center, has been crisscrossing the coastal areas, warning what a major hurricane would do to escape routes...and to the poorly built high-rise buildings that are popping up near the coastal areas. Dr. Frank demonstrates convincingly, that at least 24 hours of advance time is necessary for evacuation in many areas, and that advance time puts an undue burden on the present day forecasting capability. How will it be, if the hurricane forecasting service suffers from reduced data input during the coming lean years?

It is no coincidence that I have used the phrase "lean years", for weather forecasting is coming into this period. Part of it is the forthcoming budget cuts. Hourly weather reports...radar reports...spotter reports...aircraft reports...and satellite observations are the raw materials that go into making the forecast and preparing the warning. The raw materials are drying up in the midwest and there is nothing new on the horizon to take their place. The Doppler radar program is years away from becoming operational and, even if it should be in place, does nothing for the forecaster in the period from 30 minutes to three hours prior to the event.

As NWS stations are closed, the warning responsibility will be duly passed to another office, that already has more than it can handle. Station B will do the very best they can when station A closes, but there will be a limit and there is already a demonstrated tendency to "Cry Wolf". I started a warning verification program in 1976 for the entire U.S., for both the tornado and severe thunderstorm. The present day weather radar is inadequate for the job, for it cannot detect tornadoes per se, nor can it be sure that a thunderstorm contains damaging wind or hail. As a result, the overworked and understaffed field stations are cranking out more warnings than is justified in an effort to make sure they are covered, and nearly 90% of the warnings are radar derived. At the present time, five out of every six warnings do

not verify.

This is one of the major problems that has not been addressed within the present framework, and one of the reasons I so strongly support HR 3769. The major reason for the formation of the Weather Bureau in 1870 concerned forecasting for storms, and even today the avowed top priority of the National Weather Service is the same. But the NWS is part of NOAA and far too many of the NOAA officials do not comprehend how the weather forecast and warning service works. They are from other disciplines and more interested in fish, whales, tuna, baby seals and coastal zone management.

The research program within NOAA has been badly fragmented. The National Severe Storms Lab at Norman, Oklahoma would appear to be the ideal organization to provide the operational arm of NOAA with forecasting and warning improvements. But they have never been funded for the forecasting part. The NOAA Labs at Boulder, Colorado have gone off on different tangents, reacting more towards the way they think the NWS of the future should look like, rather than helping the operational arm with today's problems. I have been very dissatisfied with the Environmental Research Lab's role through the past ten years.

There has been a mechanism, at least on paper, that might have addressed some of the problems cited, i.e. The Office of the Federal Coordinator. The office routinely prepares a national plan, that is a cut and paste job, taking bits and pieces of each agency's individual plan. Since the Office of Federal Coordinator resides in the NOAA superstructure, they are not independent nor do they make much of a point in probing for weaknesses or in finding solutions. As a case in point, it is very possible for the DoD's Air Weather Service to issue their version of a tornado watch for a geographical area while the National Weather Service decides not to. At the present time the National Severe Storms Forecast Center cannot even find out what the AWS at Offutt has forecast.

Another unaddressed problem involves warnings. A NWS field office might issue a warning for a rural county that has an FAA facility in it, such as a VOR. Yet, that warning does not get into the FAA's communication system with any 24 hour a day certainty, so that an unsuspecting flight might be headed towards that VOR without knowing that a warning is in effect for the airspace they are flying in. These are only two of the problems that have been addressed time and time again, but have never been resolved by the existing mechanism.

I believe that the Severe Storms Advisory Committee would be a worthy addition if the policy-level individuals are willing to make it so. They must be willing to look at the nitty gritty of how station X does (some weather ^{stations} ~~situations~~ are notoriously inept in keeping the NOAA Weather Wire or NOAA Weather Radio current). They must be willing to tackle the major problem of independent television station radars. There are at least two television stations in the country with their own Doppler radar and in some markets there may be as many as six different weather radars watching the same storm evolution. The representatives from outside of NOAA, DoD, NASA, FAA and NASA must be given sufficient time and support to develop their independent views, otherwise they will be overwhelmed by the incumbents who are under instructions not to rock the boat. There must be a provision for a minority report if more than one member is willing to sign it. For that reason I believe that committee should be a little larger and that the bill should address the need for a permanent employee to make sure that this doesn't become another paper tiger by being too closely aligned with one of the principal agencies. Might I suggest that it be chaired by someone from NSF with membership open to the Bureau of Reclamation as well.

I greatly appreciate this opportunity and will be more than happy to answer any questions.

Mr. CARNEY. Thank you very much, Mr. Pearson.

We don't know where you are on the issue. Maybe we can find out through the questioning.

What I am going to do at this time is turn over the questioning to my colleague and ranking minority member of the full committee and the author of the bill, Congressman Larry Winn from Kansas.

Mr. WINN. Thank you, Mr. Chairman.

I really don't think that the witnesses today and I are too far apart on what we are trying to accomplish and what we are trying to ascertain. I appreciate the testimony. It brings back a lot of memories and reeducates me on the subject, and I am not an expert on the subject, but I have been interested in it for 15 years.

The AFOS program that Dr. Hallgren referred to, and then several of you referred to NEXRAD, are programs for which technology is available which probably could stand some improvement.

What I am trying to figure out in my own mind is, and I think George Benton brought it out pretty well, it probably should not have the power or the structure built around any one agency because I found, and some of you may disagree with this statement, but I have been in the middle of it a couple of times, jurisdictional disputes between some of your agencies. I have also accused publicly, I should say in private in meetings, NOAA for not being aggressive enough in asking for additional money. I have been urging for 4 or 5 years for NOAA to put some requests for some of the more recent technology into their requests. I told them I would volunteer and try to help them get it through the committee. But somewhere down there they seem to slip back into just what they want to do and what is working, and I respect that.

Now, of course, with the Reagan budget cuts it is going to be tough. It is going to be tough to get any money through and probably have some of the programs, the current programs, survive. Maybe postponed. They will survive because they are a technology that we need.

I still think that the idea of the Severe Storms Advisory Committee Act can be put together. What the jurisdictions are I don't know. Who is going to run it? I don't know. Allen Pearson says that the Office of the Federal Coordinator is not really doing the job. Again, I think that may come because of parochial interests.

What I want to know, particularly from the agency people, and that would be Dr. Hallgren and Mr. Crawford, who really sits down and quarterbacks this plan and who sits in and who has the input and who tries to make all of the plans that everybody is involved on work better?

I suppose it comes under the Federal Coordinator. I guess that must be the quarterback. But I am sort of looking at you.

Dr. HALLGREN. Then I guess since I have been the Federal Coordinator three times in my life at various stations I shall try to respond to that.

First of all, the structure—and I don't want to bore you with it—is that we have a Federal Committee for Meteorological Services and Supporting Research and through that committee the representatives from a policy level in the various agencies that are involved in those activities are represented.

Mr. WINN. How often do they meet?

Dr. HALLGREN. They do not meet often. In fact, they haven't met in the course of the last 6 months.

Mr. WINN. OK. That's one for my side.

Dr. HALLGREN. It is clearly for your side.

But a couple of years ago we were meeting much more frequently when it was in fact at that time chaired by Dr. George Benton, and in fact I think, Mr. Congressman, we are going through a transition period right now in the structure and we will be bringing that committee into more active participation in the near future.

But the primary work is done—and committees only do so much, sir—by the Federal Coordinator and his staff. We have about eight people that are working on the coordination of the overall activities and they generate the information that appears in the reports that you have received.

Mr. WINN. Do they represent the different agencies that we are talking about?

Dr. HALLGREN. Yes; on the staff itself there are people formally assigned by DOD, the Department of Transportation as well as NOAA. So there is a lot of harmony there.

Mr. WINN. FEMA?

Dr. HALLGREN. FEMA is represented on the committee structure. It has someone formally in there.

Mr. WINN. FAA?

Dr. HALLGREN. FAA, yes. That's where the person from the Department of Transportation comes from.

But what I was referring to when I said that the Federal Coordinator mechanism could be put to work and used in developing the national program I was going back to the time when we had a focus, when we were saying let's go after and really collectively in this Nation mount a major effort related to the large-scale motions that came under the overall program called the global atmospheric research program.

There, sir, through the Federal coordination mechanism we called upon the Academy of Sciences to bring the best scientists together. And then subsequently after they had put together a scientific plan in which the agencies were helping on the subset, it was brought within the Federal coordination mechanism and there we developed which agency was going to do which part of it, and I think we carried out that program quite well. And I was saying that whenever you have a focused effort like you are calling for here the combined efforts of those two groups can work effectively.

It is true that whenever you get so that you are questioning one agency's mission versus another it becomes a little more difficult in the Federal coordination mechanism. But that isn't the challenge that is before us on this. It is how to bring together the best national effort, and it is in that area I think the machinery works better than in the others.

Mr. WINN. Let me point out, and then I will have some questions of some of the other witnesses, you talk about the mechanism of the Federal Coordinator for Meteorology. Yet the GAO in 1979 issued a report that says the Federal weather program must have a stronger sense of direction. They said it is too informal and too limited to insure that the Federal agencies use the best service ar-

rangements. It lacks an enforcement mechanism, which we all know is true, to influence the budgetary authority and to prevent unnecessary costs.

Allen Pearson offered today, and I have heard him do it before, much of the same criticism of the Federal Coordinator in his testimony. And since he is not in the Government anymore maybe it was a little stronger today than it has been in the past.

Don't you think that this committee would be critical—no matter what the makeup is? And I don't necessarily disagree with you. I am not set in mud on that, George. But don't you think that whatever the makeup of the committee might be, basically of the groups we talked about, and possibly some from the science community and maybe the National Science Foundation should be included in that, the university community, it shouldn't be too big. If you get it too big then you have a terrible time putting a report together. I am not one of those in Government that wants just a report to be sitting somewhere. I want the report to try and accomplish something and to help us make some new strides. The fact that the Government would require a report, according to this bill, don't you think that would make the advisory committee stronger than it is under the Federal Coordinator? Any of you?

Why don't you answer it, Dr. Hallgren.

Dr. HALLGREN. I will be very brief and then the others can comment on it.

I can always see an advantage to being told that you have to have it by a certain date. What I was looking at was more generally as to whether an existing mechanism could accomplish what I think your goals are, and I was saying that I thought it could.

Mr. WINN. It could. That's why I say I don't think we are too far apart on that.

Mr. CRAWFORD. Mr. Winn, I might add from the standpoint of FEMA, with regard to the interdepartmental committee and just for the information of you and the other members, that when FEMA came together in its present configuration only about 2 years ago there had been a number of relationships between the emergency management agencies that came together and the various parts of the meteorological system coming into FEMA, into the research arm at that time and the research applications responsibility in my case. I recognize that the interdepartmental committee might be a useful vehicle to us to help get some of the emergency management needs into the research agenda of the meteorological community, and as a result we began to participate with the interdepartmental committee, as Dr. Hallgren can substantiate.

We have established, and we are only beginning to work this out, but there is an ad hoc group on meteorological planning for emergencies, which is established within the context of the interdepartmental committee. And we hope that that will be a useful mechanism to feed some of our type of user input into the R&D agenda of the community to express some of the needs that we have on the streets where the implications of the storms are happening so that we might get the better bang for the buck in terms of the research that is being performed.

So we are very hopeful that that device is going to prove a good systematic approach for us into the community broadly. We have found it to be a very profitable relationship to this point.

Mr. WINN. But you are still dealing only with the Federal agencies and you are not going outside. You are not really having anybody look over your shoulder.

Mr. CRAWFORD. That's right, sir. It's a partial.

Mr. WINN. You mentioned the term that it seemed like I heard 10 or 12 years ago that "we hope that this is going to work out all right." And I am past that stage of hoping. I want to try to get something that your agencies would agree with, that members of this committee and the full Committee on Science and Technology would. A companion bill has been introduced on the Senate side. So there is a lot of interest in it. How we arrive at the end result could take us several different directions.

While I am talking to you, Mr. Crawford, I recall the Wichita Falls, Tex., tornado several years ago that we all remember. A significant cause of the deaths that occurred were caused by complacency, which any of us who have been through any tornadoes see it left and right. We can't understand it, but it is there. People continued to shop in that shopping center in spite of the warnings and the sirens of an approaching tornado.

How is that type of phenomena considered in the severe storm warning system? Is it discussed? I know it is discussed. But after you discuss it where does it go? Do you have any plans? Does NOAA or FEMA or any of the agencies have any plans to incorporate that in the psychology or change the warning system so that we are not crying wolf, that when we issue the warnings we know we have trouble coming?

Dr. HALLGREN. Of course, that is always of significant concern, and Allen Pearson knows it better than probably any other person in the country. In fact, maybe Neil Frank and Allen are equal in that sense since they were handling the tornadoes and the hurricanes respectively. But we see that whenever we have our disaster surveys after a particular event, and Wichita Falls was one example. What we are trying to do is bring about a better and better awareness, constantly bringing it to the attention of the local officials, trying to get it to the public. We are trying to do that on NOAA weather radio, constantly bringing out with short segments what is happening, what potentially could happen and what you should do whenever you hear a warning.

Mr. WINN. I am aware of that, and I think you do a basically good job. But you are doing an educational job and that is what has to be done. How do we approach it from a psychology standpoint, because you know and I know all you have to do is watch some of the weather forecasters these days and half of them are actors and they ought to go to Hollywood. There is so much of an actor or a theatrical production that really I don't know how much credibility people put into that performance. I won't mention any names, but we have some right around here.

Mr. CRAWFORD. Mr. Winn, if I might add to what Dick has said, from the standpoint of FEMA there has been over the years in the DCPA, the Defense Civil Preparedness Agency, context and others, and in the work of the National Science Foundation, there have

been analyses of the reaction of population, as you know, to warnings and things of that sort. And I might refer you to a fairly recent report which has been done on community response to natural hazard warnings which was done at the University of Minnesota. I think a copy of that has been provided to Dr. Palmer. It was by Messrs. Lee, Carter, and Clark.

In that particular study they look at the issue of what community organizations are involved in, disaster warning processes and a study of household responses to warnings and then a laboratory experimental study of the response to warnings.

This is just one example of the kind of work that is being done. This is a fairly recent report which has been received in FEMA and it will be taken into account as we develop our program in the area of hazard mitigation.

I am sure Dr. Thiel, if you would like to pursue that particular report or this general subject in more detail, would be glad to elaborate or respond to.

Mr. CARNEY. We will take that report and submit it as part of the record. It has been delivered to our staff. It will become part of the hearing record.

Mr. WINN. I might say that out of that—I haven't seen it—report I am sure we could develop some more questions based on that. I don't know that I am, but I am probably one of the few if not the only Congressman that has done a separate survey on his own following up a civil defense warning. I was given the date and then I had people call. I used the radio, television, and volunteers to call and get the reaction of some of your volunteers. It was pretty discouraging.

I won't go into the results. I have those. But we have not done a good job. Most of them went right ahead about their business, or didn't hear it, or their siren was off and they couldn't hear their siren, or they were too busy picking up Johnny at school, or whatever the excuse was. People did not react well. They didn't react the way that you are trying to say that they should for the time and energy that you are spending trying to educate them.

Mr. CRAWFORD. Well, sir, I do agree with you. I think that it is an area that we don't know as much about as we should.

Mr. WINN. Should it be included in the discussions? Should it develop a higher priority in your discussions, whatever your group meetings might be at the present time?

Mr. CRAWFORD. Yes, sir, it should be and it has been.

Mr. WINN. Well, what are you doing about it besides talking about it?

Mr. CRAWFORD. Well, in the involvement of the FEMA in particular with regard to radiological emergency preparedness program in terms of offsite. There's been an offsite warning and response. There has been quite a bit of an analysis done and we tried to factor in the best that we know into the planning for those offsite situations.

I might mention, sir, that Dr. Thiel leaned up while you were making your comment and he mentioned to me that this particular study at the University of Minnesota, to show you that we aren't really covering this area awfully well, is the only substantial study

in the last decade of this particular area. So we do need to do more work.

Mr. WINN. Allen, you mentioned raw materials; raw materials are drying up in the Midwest and there is nothing new on the horizon to take their place. What do you mean by raw materials? I think I know.

Mr. PEARSON. Surface reports. I should add that I am now one of these weathercasters. I'm on a CBS station in Kansas City on the weekends. I will never win any awards for my acting.

Mr. WINN. You've got a good reputation out there, whether that offsets your acting ability or lack of it.

Mr. PEARSON. I was working Saturday. The St. Joseph tower was closed due to budgetary cutbacks. Beatrice, Nebr., was closed due to cutbacks. Jefferson City was closed due to cutbacks. Pampa, Iowa, was closed due to cutbacks. And there was no way you were going to get mesoscale data or stormscale data without somebody supplying it for you.

Mr. WINN. That's the regional storm that George was talking about.

Mr. PEARSON. Yes; we have areas in the Midwest where you could put Rhode Island and Massachusetts without having a weather station that is open 24 hours a day.

Mr. WINN. What is the reason for those cutbacks? Is that part of the austere Reagan program?

Mr. PEARSON. Part of it is the austerity and part of it to take the controllers from there and put them into the big airports because of the PATCO walkout. But the meteorologist ends up hurting. I put words in Dr. Hallgren's mouth, but I imagine if he finds out those stations are closed permanently it will take several years before some automatic equipment is put in there to take its place.

Mr. WINN. But there is automatic equipment that can take its place.

Mr. PEARSON. It is available if it can be purchased.

Mr. WINN. It is expensive.

GAO criticized NOAA—I'm aiming this at you, Al—for not having an effective means of communicating operational needs to its research scientists. Earlier you seemed to agree with that assessment when you said that you are disappointed with NOAA's environmental research laboratories. What means, what constructive means should NOAA take to improve this lack of communication?

Mr. PEARSON. Well, I think the operational arm must be given a mechanism where they say here is what I believe that we need to make things work over the next 2 or 3 years. Admittedly, the person such as myself who is in day-to-day forecasting may not have the long picture. He may not care what is going to be happening in 10 years. You are only caring vitally with what is happening today and tomorrow.

But there must be some way of putting your requirements in and not only have a chance to argue your case, but if you are turned down to at least make some kind of an appeal process. At the present time the situation is weak. There is not a long-term plan. You come in on the tag end of some of these other programs, such as the SESAME, which was in operation the day of the Wichita

Falls storm. In fact, I was working that day myself. Eventually you got some payoff on that, including the Doppler radar, but as far as the technology, there wasn't any technology that came out of the SESAME that was immediately transferable to the storm forecasts.

So there just has to be more interplay.

Mr. WINN. George, do you think that if we could get this advisory committee together and everybody just sit down and say, OK, we have got to work together and we are going try to make this thing work and we are not going to just put together a report for the Government and let it stack up, but out of that report we are going to say take this priority; this is something we can afford under the present circumstances; we would like to have this in a long-range forecast; we would really like to have improved Dopplers and some of the other things; but here is what we can afford and here is what we recommend. Then get all of those people and those agencies and the university community and all of the outside consultants, whatever we ended up with as far as the number is concerned, and I am open for change on that if somebody has got a better idea on the numbers—do you think that would give us what we are looking for? Or would it improve it?

You don't have to agree with me. I really don't know if it would or not. Could it work?

Dr. BENTON. I imagine it is possible it would work, but quite frankly I think the odds would be against it.

Mr. WINN. Why?

Dr. BENTON. Perhaps I could go back to the 3 years when I chaired the Federal Coordinating Committee, which was a policy level committee in atmospheric sciences. When I first came to Government, just as now, that committee had not met for well over half a year. I think when each new administration comes in there is a change in personnel at the policy level and there is a hiatus. But I think also there were longer term changes that were involved because somehow in the interagency business meteorology seemed to have slipped in terms of its urgency and importance.

We got the committee going again and there were a large number of us involved in it. In the last 2 years that I was in Washington the Federal Coordinating Committee met three times a year. I cannot honestly say it was a tremendous success.

The reason for that, quite frankly, was that most of the agencies that participated did not send their members. Nominally a policy level member was there from every agency. In practice they were usually very few hours in the chair. NASA almost always sent a policy level person. But when you went down to the other agencies it was very rare that I saw someone who was really the member. Instead I would see a series of substitutes who when the chips were down and there were some decisions to make would have no authority and would always have to go back to his agency and consult with them.

I don't think these committees work very well, in all honesty, except to react. If we could find problems that we knew we had to solve we could flag them as problems before a meeting, ask for information or solutions from our staffs and get reports that could sometimes resolve or iron out the difficulty.

Mr. WINN. Well, isn't the challenge there? I think one of you mentioned a little while ago the challenge is still there to do a better job. It is supposed to be built in to your people.

Dr. BENTON. I think that the real way to do a better job is to do it at the working level. Underneath the Federal Coordinating Committee, which I chaired, there is a Federal Coordinator's Office which has a permanent staff. The agencies that are most interested participate directly. There are various working committees. For example, for many years there was a working committee on radar which worked very closely between the concerned agencies and which ultimately led to the formation of an interagency program on NEXRAD. The basic work for that was done at the working level where people take pride in their job, where they want to get things done and where they develop communications across agencies.

I think these more grand committees are better for putting a rubber stamp of approval on something that has been worked out. Or if it hasn't been worked out, saying this isn't satisfactory. Give us another try.

But they are not very good, in my experience, in really leading the way. They are better in terms of reacting to problems that have been flagged to them. And very often when something successful is done it is because the working level groups have identified the problem and started to work at it on their own.

So I think that you can expect too much from these committees, and I again flag the warning that if policy level members of the executive branch are formally members of this committee, in all probability any report that they sign their names to will have to be cleared by their agencies and by the executive branch, and I think you will have the meat pretty well wrung out of that report before it sees the light of day.

Mr. WINN. Well, I don't want to do that. That isn't the kind of report I am looking for. If that is what is going to happen, we are just spinning our wheels here. I see enough of those.

Dr. BENTON. Well, that's the reason for my suggestion, Congressman Winn, that this committee be external to the executive branch in its membership, because such people, as we have demonstrated here today with Allen Pearson, and I think to some extent with me, these people, once they are not in the Federal Government, are much more free to speak their minds on those issues.

Mr. WINN. Why can't we combine both the Government, the agency people, and the people outside of Government? That's why I think the Federal Government, the agency people need someone looking over their shoulder or else we are going to get a washed out report.

Dr. BENTON. They may need someone looking over their shoulder, but as I said before, I think before any policy level representative of a Federal agency signs his name to a report or approves a report it will have to be cleared by his agency, and quite possibly by OMB.

Mr. WINN. That's my last comment. Mr. Chairman, I appreciate your generosity on time. I figured out that I have taken about 40 or 45 minutes, but there are four witnesses, so spreading that out, I didn't cheat too much. [Laughter.]

What you are saying is that a blue ribbon committee is not going to get the job done; it may take a red ribbon second place, or a white ribbon third place committee down to the workers to get the real good reports out.

Dr. BENTON. I think that Dr. Hallgren's comments about the world weather watch and the global atmospheric research were excellent. He emphasized the Government side of it. Since I was in the academic community in those years, let me emphasize the non-government side of it.

There were two parallel groups. There was the National Academy of Sciences group, which was composed partly of senior scientists from the academic and research community and partly from scientists from within Government who were there as individuals, not representing their agencies. But they were selected because of their scientific ability, not because of their administrative position.

Mr. WINN. Yes; but that is pretty hard to separate, isn't it?

Dr. BENTON. No; it is not, because these people that are not speaking for their agencies we do have in the National Academy of Sciences. Scientists from Government agencies are participating. But they participate as individuals, and this is clearly understood by all. So when they sign the report they are signing only as individuals.

Now this committee, I think, was very effective in pointing the general direction, in charting a path, in laying very broad scale plans. But it had no money; it had no authority; it could not carry out the plans. The plans were carried out within Government by an interagency committee which really took this overall group and tried to implement what it could realistically do.

I think Dr. Hallgren would agree with me that the intellectual leadership, the real leadership as to what direction we should go was in the Academy committee and that the in-house Government committee was an implementation committee. And I believe these interagency committees within Government work much better in this mode.

Mr. WINN. Thank you very much, gentlemen. I appreciate your comments today. I find them very interesting and very enlightening. I do have a few more questions of each one of you and I am going to ask the chairman to allow us to send those to you. I will try to hold them down, but I do want to put them in the record. And if you would answer us by mail as soon as possible, it would be very helpful.

I want to again thank the chairman for allowing me this much time. I should say that I am cutting it off now because we have been informed that there is a 4:45 State Department briefing on President Sadat's death, and I think most of the Members of Congress will want to be at that briefing.

Thank you very much. Thank you, Mr. Chairman.

Mr. CARNEY. Mr. Winn mentioned that meeting. I would like to say Mrs. Schneider had to leave to prepare for that meeting and certainly our chairman, Mr. Scheuer. Because of the events of the day our schedules have been kind of flip-flop and it is not a reflection of our concern on this issue.

I would just like to ask a couple of questions and then I think we can adjourn this meeting as quickly as possible so we can all make our appointed rounds.

Dr. Hallgren, was I right in hearing that the Federal Emergency Management Agency has not participated in the coordinating committee?

Dr. HALLGREN. No; quite the contrary. As soon as it came into place—in fact Bob and I met because I was in my second incarnation as Federal Coordinator and drew FEMA into the group and they have been participating very effectively. I am not saying that all things are solved and all things are done, but they have been working from the very beginning at the agency in the Federal Coordination Center.

Mr. CRAWFORD. I think perhaps, Mr. Carney, what you overheard was Dick's statement that FEMA does not have a staff person assigned to the Federal Coordinating Office, and that is correct. We do not at this point. There are a number of other agencies that do.

Mr. CARNEY. And you have the agency or the committee that has not met in a 6-month period.

Dr. HALLGREN. You see, that's the Federal committee. There is a whole structure of committees that get down into particular areas. The Committee on Operations meets very frequently, every 2 or 3 months. So it has continued right throughout.

You have to keep in mind what George Benton said, about the Federal committee, that we try to get the policy people on that committee. They change with the change of administration, and therefore there is no sense, in my opinion, to be bringing in the people like myself that exist all the time, or hopefully exist all the time in Government, back to meetings because we are meeting on the next plane which continues on. Then when we get the policy people in place with the new administration, then we bring them together.

Mr. CARNEY. The policy people in this administration haven't come under the same tent yet?

Dr. HALLGREN. Well, not all the people are in place yet. Keep in mind in all the appointments that would normally show up in this committee are just now coming into place. It takes some months to get those people in place.

Mr. CARNEY. But then again you think you are doing an effective job of coordinating the different Federal agencies.

Dr. HALLGREN. Yes. I think we still think we continue.

Let me just clarify. I am not saying myself that we have solved all the problems. But what I am saying, when I look at it overall, I think the Federal coordination mechanism is doing a good job. And those two that Allen raised, I will go and get to work on those and check those out. Frankly, those are bilateral problems between two agencies and as Federal Coordinator I will work them out, tell myself to work them out bilaterally with another agency.

Mr. CARNEY. Ofttimes when people are faced with problems the problems could be solved, but there is a communications gap, and there seems to be a communications gap in this area with the Congress, because certainly many Members of Congress share the concern that the author of the bill has in this area about the coordina-

tion and the activities of all our Federal agencies as it pertains to severe storms.

Again, too, there is perception, and that is the public's perception as to what we are doing in that area. There seems to be a lack of confidence perhaps in the public that the Federal Government is moving in any one organized direction to address this problem with the current state of the art mechanisms that we have and address this problem with one voice from several agencies that deal with it. Just that, if I dare say, presents a political problem to every member who is faced with a constituency.

I live on the eastern part of Long Island. We have that same constituency that Mr. Winn would have in Kansas or someone would have in Nebraska. We have hurricanes. Fortunately it has been years since a severe hurricane has hit our area. We don't know when the next one might come. But we would certainly like to be prepared as possible and we would certainly like to have the knowledge that the Federal agencies involved in these dilemmas are all on the same sheet of music and coordinating and cooperating with each other.

There seems to be the lack of that confidence and there certainly seems to be the lack of communications to the Congress. I am left in a frustrated position. Certainly I support Mr. Winn's bill. I think it is very, very important. I know it might come from funny quarters. Maybe that's not the word when I am addressing Mr. Winn. But Mr. Winn has been a staunch supporter of the administration's proposals to cut back on Government. He detests committees as much as I do, and he is left with nothing but to put this bill in. I appreciate his frustrations and I have the same, and I am going to support the bill.

Maybe I am not asking a question but making a statement that might get back to the various agencies so they would have an understanding of our frustration. It is a difficult thing, because we are trying our very best. You know, from the day I found out when I first came to this Congress that before you come up here you put everything under the nose of OMB it has been very frustrating to talk to a Federal witness. I am tired of getting the washed copy. It is not productive. It is not helping anybody. And I would just hope that you would take our message back. We hate to have to force it through legislation, but this is the frustration that we have. You know, as a matter of statement, not as a question.

I praise my colleague from Kansas for taking these motions and I know perhaps it goes against his grain, because he would be the fastest one in the world to say we don't need another committee, but every once in a while there is a sufficient reason to go against your philosophy, and I think this is demonstrated here.

Dr. HALLGREN. I would just like to say that we appreciate your interest because we know that this particular problem that Mr. Winn has so correctly identified is extremely important, I think, to the people of the United States.

Second, I have no trouble in having people from outside the Government or any place looking over our shoulders. Frankly, invariably they conclude that first of all, we're pleased with it, we do a good job and we need more support. And frankly I appreciate that.

And third is that my only goal is to see the warning system in this country improved in the years to come. In whatever way you all decide I will be with you in trying to achieve that.

Mr. CARNEY. We certainly appreciate that. In order for that to happen as expeditiously as possible and with the right price tag on it a coordination is necessary and the Congress has to be informed, and if this is the only way that we can do it, then our frustrations are left to Mr. Winn's bill. We hate to be continually involved in directing administrative agencies, trying to tell them how we want them to do their business, but sometimes we are left with nothing else.

I believe that is a real quandry, Mr. Chairman, and I finished all my questions.

Mr. WINN. I would just like to ask the agency people if they know anything that they have heard about in the last month or two of the calendar year having to set aside and hurry up and spend some money in the last couple of months so that the budget will turn out like it looked at the first of the calendar year.

Dr. HALLGREN. Would you say that one again?

Mr. WINN. It is wrapped around the hurry up and spend what we have left in our budget at the various Federal agencies—I am not looking at yours alone—so that we can come up with the same budget or more the following year, the next year. Hurry up and spend the money we have got left in the till and that happens frequently in many of the agencies the last 30 days of the calendar year—the fiscal year. I'm sorry.

Mr. CRAWFORD. Speaking for FEMA, we have at least been under some, I think, if I am not mistaken, congressional edict that only a certain percentage can be obligated in the last quarter, and our agency has paid particular attention to that. So I don't think that that has been a problem.

Mr. WINN. It used to be.

Dr. HALLGREN. It has never been a problem in the Weather Service.

Mr. WINN. Thank you very much.

Mr. CARNEY. Thank you, Mr. Chairman. This meeting is now adjourned.

[Whereupon, at 4 p.m., the hearing was adjourned.]

